# SUN FIRE™ X4170, X4270, AND X4275 SERVER ARCHITECTURE

## Optimizing Performance, Density, and Expandability to Maximize Datacenter Value

White Paper
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**Abstract**

In compact 1U and 2U form factors, the Sun Fire X4170, X4270, and X4275 servers combine the power of a new generation of Intel Xeon processors with Sun's system engineering expertise. Based on Sun's Open Network System design approach, these servers offer the needed performance, density, and expandability to satisfy demanding datacenter applications, especially for virtualization and consolidation initiatives. This white paper describes the architecture of the Sun Fire X4170, X4270, and X4275 servers, including the processor technology, I/O subsystem, built-in system management features, and range of supported operating systems.

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# Executive Summary

Datacenter complexity, energy, and cost issues continue to plague businesses and their ability to operate effectively within tight budget constraints. In recent years, an increase in the number of collaborative, Web, and data-centric applications has driven up the number of datacenter compute servers, adding to the administrative workload and compounding an already difficult IT management task. Complexity can sometimes result in severe business impacts, slowing productivity, extending development cycles, and delaying time to market. While datacenters try to cope with increasing complexity, they strive to control energy and other operating costs, while still keeping pace with the growing demand for computing and storage resources. To achieve greater business and datacenter efficiencies and enhance agility, many small businesses and larger companies are turning to consolidation and implementing virtualization initiatives.

For more than 25 years, Sun has focused on solving customer problems by engineering solutions based on innovative technologies that deliver differentiated value. Sun's Open Network System approach combines innovative technologies, cost-effective and industry-standard components, and Sun's expertise in delivering dense, high-performance systems. This focus, along with an emphasis on eco-responsibility, is evident in designs of a new Sun platform family — the Sun Fire™ X4170, X4270, and X4275 servers — which are ideal for supporting consolidation and virtualization.

Using state-of-the-art Intel® Xeon® processor technology (codenamed "Nehalem"), Sun has engineered powerful 1U and 2U systems that are well-suited for HPC, grid computing, database, Web infrastructure, as well as consolidation and virtualization. These systems offer density and expandability in compute, memory, storage, and I/O subsystems, including the integration of low-latency, enterprise-quality solid state disk (SSD) drive technology. These systems are also highly energy-efficient and offer flexible support for multiple operating systems — the Solaris™ and OpenSolaris™ Operating Systems, Linux, Microsoft Windows, and VMware.

The Sun Fire X4170, X4270, and X4275 servers showcase Intel's talent for creating high-performance commodity chipsets along with Sun's advanced engineering and quality system design. Engineered for mission-critical availability, these servers feature several redundant and hot-swappable components and built-in system management tools. With efficient front-to-back air flow, highly efficient power supplies, and Intel's built-in processor power management technologies, these servers are engineered to conserve valuable energy resources, which helps to lower day-to-day operational expenses. By taking advantage of Sun's expertise in Open Network System design, these servers deliver innovation that optimizes operational efficiency and economics in the datacenter.

Chapter 1

# Managing Capacity and Complexity

## Introducing the Sun Fire™ X4170, X4270, and X4275 servers

To help IT managers optimize value and reduce complexity in the infrastructure, Sun offers a new series of Intel® Xeon® processor-based systems — the Sun Fire X4170, X4270, and X4275 servers — based on Sun's Open Network System approach. This approach blends cost-effective, industry-standard components with innovative technologies, yielding compact 1U and 2U servers with unprecedented density, high performance, and energy efficiency. The Sun Fire X4170, X4270, and X4275 servers offer:

- *Advanced levels of performance.*The Sun Fire X4170, X4270, and X4275 servers share a common motherboard that contains two sockets for Intel® Xeon® Processor 5500 Series (formerly Nehalem-EP). With new HyperThreading technology, these CPUs can provide twice as many compute threads as previous generation processors. They also support enhanced power management features, the new QuickPath Interconnect, and Intel "Turbo Boost" technology that helps to deliver new levels of performance while lowering power consumption.
- *Remarkable density.* Density is the cornerstone of the Sun Fire X4170, X4270, and X4275 server designs. When populated in a 42-rack unit (RU) enclosure, the 1U Sun Fire X4170 server facilitates a single rack with up to 84 processors, 756 DIMM slots and 126 PCI Express (PCIe) 2.0 slots. In a single 2U chassis, the Sun Fire X4275 server supports up to 12 terabytes of internal storage (based on 3.5-inch SATA devices). These servers provide the density needed for consolidation and virtualization initiatives — many smaller servers can be merged into a single Sun Fire X4170, X4270, or X4275 server to conserve space, lower energy expense, and reduce costly administrative talent. Support for multiple operating systems helps to streamline consolidation, simplify virtualization, and diminish server sprawl.
- *Extensive system expandability.* The ability to expand a server over time reduces the need for additional capital acquisitions and lowers application lifecycle costs. The 1U Sun Fire X4170 server enables a maximum of eight internal 2.5-inch hard disk devices (HDDs) while the 2U Sun Fire X4270 server provides up to sixteen 2.5-inch devices and up to six 8-lane PCIe 2.0 slots. With an innovative new 2U chassis enclosure that can house 3.5-inch devices, the Sun Fire X4275 server supports up to twelve internal HDDs and up to six PCIe 2.0 slots. All three server models are available with four on-board Gigabit Ethernet ports, and can be configured with either SAS or SATA hard disk drives. In addition, these servers are designed from the ground up to accept low-latency solid state disks (SSDs) for performance-intensive applications. Because these servers can easily integrate enterprise-quality flash technology and offer such expandability, they can scale easily to support new users, more transactions, and new 32-bit or 64-bit applications, enhancing longevity and increasing overall ROI.

- *Improved energy efficiency.* Sun offers a portfolio of eco-responsible products and computing solutions to address customers' needs to reduce energy consumption. In the Sun Fire X4170, X4270, and X4275 servers, the Intel Xeon Processor 5500 Series incorporates new technologies that decrease power consumption when processing workloads diminish. When the workload is low, the new Intel® Core Microarchitecture (codenamed Nehalem) adjusts power use, reducing processor frequency, limiting power to unused execution units in each core, or temporarily disabling "Turbo Boost" features, which together can help to decrease power and cooling requirements. High-efficiency power supplies in the server chassis also lower overall power consumption. Variable speed fans, disk carrier design, and front-to-back air flow help to effectively cool the system and maintain appropriate processor and system ambient temperatures, which also help to minimize the energy footprint.
- *Enterprise-class high availability.* The Sun Fire X4170, X4270, and X4275 servers are designed with enterprise-class RAS (Reliability, Availability, and Serviceability) features. To maximize uptime, systems include redundant hot-swappable fans and are configurable with redundant hot-swappable power supplies. Using a Sun StorageTek™ SAS RAID Host Bus Adapter (HBA), internal SAS or SATA disk drives can be configured for RAID 0, 1, 1E, 10, 5, 5EE, 50, 6, and 60 —when mirroring is implemented, drives are also hot-swappable. Four integrated Gigabit Ethernet ports enhance network availability — without consuming a PCIe 2.0 slot — and can be implemented in failover configurations. On-board system management tools encourage remote, proactive monitoring and intervention.
- *Simplified system management.* To support out-of-band management, the Sun Fire X4170, X4270, and X4275 servers incorporate a service processor that features robust "lights-out" management capabilities. This built-in functionality allows administrators to monitor and manage systems remotely, enabling corrective action and minimizing unplanned downtime. New "side-band" management capabilities allow one of the four on-board Ethernet ports to be configured for system management, which can reduce the number of network switch connections needed.

The Sun Fire X4170, X4270, and X4275 servers combine powerful compute performance with expandable storage, memory, and I/O resources. As a result, these systems are designed to scale up, scale out, and scale within, enabling implementation in a wide range of application architectures:

- *Scale-up architectures.*With multiple cores and processing threads, these servers are well-suited to scale for growing workloads that deliver Web, database, and other key infrastructure services.
- *Scale-out architectures.*With the Intel QuickPath interconnect technology, large memory capacities, internal storage, four Gigabit Ethernet ports, and high-bandwidth PCIe 2.0 expansion for high-speed system interconnects (such as fiber

channel and InfiniBand), these servers can scale to solve complex computing problems that demand intensive compute power and data bandwidth.

- *Scale-within.*With the ability to support industry-leading virtualization software (including VMware, Microsoft Hyper-V, and Sun xVM, these servers are ideal systems to consolidate applications within a single extensible platform.

Figure 1 shows the 1U Sun Fire X4170 server and the 2U Sun Fire X4270 and X4275 server enclosures.

Sun Fire X4170 Server

Sun Fire X4270 Server

Sun Fire X4275 Server

*Figure 1. Sun Fire X4170, X4270, and X4275 servers*

## Comparing the Sun Fire X4170, X4270, and X4275 servers

Sun established a de-facto standard for system design with its Open Network System approach by integrating and optimizing open compute, storage, networking and software technologies from across the company's portfolio to deliver high performing, efficient, and scalable systems. Following the same design approach, the Sun Fire X4170, X4270, X4275 servers are engineered to deliver operational efficiencies and optimize datacenter value. The three models are targeted as follows:

- The Sun Fire X4170 server is a compact enterprise-class x64 server that can power demanding mission-critical back office applications.
- The Sun Fire X4270 server is ideal for virtualization initiatives in branch office or departmental settings, or for moderate complexity data center consolidation needs. It features excellent expandability for memory, I/O, and a large number of internal drives, which helps to support demanding virtualization requirements.
- The Sun Fire X4275 server is an ideal storage server to drive near-line storage solutions for rich media or data warehousing applications. Its high density and storage capabilities encourage substantial savings in cost, energy usage, and datacenter space, which helps to optimize value.

Table 1 summarizes features of the Sun Fire X4170, X4270, X4275 server platforms.

*Table 1. Feature Comparison for Sun Fire X4170, X4270, and X4275 servers*

| Feature | Sun Fire X4170 Server | Sun Fire X4270 Server | Sun Fire X4275 Server |
|---|---|---|---|
| Chassis | 1U | 2U | 2U |
| Number of CPU sockets | 2 | 2 | 2 |
| Supported processor type | Intel® Xeon® Processor 5500 Series | Intel® Xeon® Processor 5500 Series | Intel® Xeon® Processor 5500 Series |
| Processor system interconnect | Intel® QuickPath Interconnect | Intel® QuickPath Interconnect | Intel® QuickPath Interconnect |
| Number of memory slots | 18 | 18 | 18 |
| Memory capacity | Up to 144 GB (using 8 GB ECC RDIMMs) | Up to 144 GB (using 8 GB ECC RDIMMs) | Up to 144 GB (using 8 GB ECC RDIMMs) |
| Memory type | DDR3 RDIMM | DDR3 RDIMM | DDR3 RDIMM |
| Internal storage: Supported device size | 2.5-inch | 2.5-inch | 3.5-inch |
| Internal storage: Number of devices and types | Up to 8 SAS/SATA HDDs (SAS RAID HBA required) or 6 SATA HDDs or 4 SSDs (without an HBA) | Up to 16 SAS/SATA HDDs or 8 SATA SSDs (SAS RAID HBA required) | Up to 12 SAS/SATA HDDs or 8 SATA SSDs (SAS RAID HBA required) |
| Removable media | Optional SATA DVD/RW; internal USB port and compact flash socket for flexible internal boot devices | Optional SATA DVD/RW; internal USB port and compact flash socket for flexible internal boot devices | No DVD/RW option; internal USB port and compact flash socket for flexible internal boot devices |
| Number of PCIe 2.0 slots | Three total (1 x16, 2 x8) | Six total (all x8) | Six total (all x8) |
| Number of GigE ports | 4 on-board | 4 on-board | 4 on-board |
| Number of USB ports | 2 front, 2 rear, 1 internal | 2 front, 2 rear, 1 internal | 2 rear, 1 internal |
| System management | On-board ILOM service processor. Side-band management via on-board GigE port or through 10/100 Ethernet system management port | | |
| RAS components | Hot swappable and redundant power supplies, fans, disk drives; RAID 0, 1, 10, 1E, 5, 6, 50, 5EE, 60 provided via optional SAS RAID HBA | | |
| OS support | Solaris OS, OpenSolaris, Linux (32/64-bit Red Hat or SuSE Linux), Microsoft Windows, VMware ESX Server | | |

As Table 1 shows, the systems share a number of features, including:

- Up to two Intel Xeon Processor 5500 Series (codenamed Nehalem-EP)
- Integrated memory controller supporting up to 1333 MT/s registered DDR3 memory modules (memory is organized in three channels per processor)
- Multiple point-to-point Intel QuickPath technology-based interconnects
- Turbo Boost mode and HyperThreading capabilities
- Intel 5520 chipset (Tylersburg-36D) and Intel 82801JR I/O Controller Hub (ICH10R)
- Large-capacity internal storage, including support for solid state drives (SSDs) as well as hard disk drives (HDDs)
- PCIe 2.0 expandability
- Built-in quad Gigabit Ethernet support
- An on-board ILOM service processor for system management
- Enterprise-class RAS features including redundant, hot-swappable power supplies, fans, and drives
- Support for multiple operating systems

Notable differences between the Sun Fire X4170, X4270, and X4275 servers include:

- Chassis enclosure (1U versus 2U)
- Maximum number of devices supported for internal storage
- Support for 2.5-inch versus 3.5-inch internal storage devices
- PCI 2.0 expansion capabilities (three PCIe 2.0 slots versus six PCIe 2.0 slots)

Multiple off-the-shelf configurations of each platform are available, along with a wide spectrum of options to tailor each system for specific workload requirements. The Sun Fire X4170, X4270, and X4275 servers offer the density and configurability necessary to realize operational, administrative, and energy cost-savings — the goals of many IT strategic plans.

## A choice of operating systems

To optimize flexibility and investment protection, Sun Fire X4170, X4270, and X4275 servers support a choice of operating systems, including:

- Solaris Operating System (OS)
- OpenSolaris Operating System
- Linux operating systems (32/64-bit Red Hat or SuSE Linux)
- Microsoft Windows Server
- VMware ESX Server

Chapter 5 describes the OS releases supported as of this writing. Please see sun.com/x64 for the latest information on supported operating systems and environments.

Chapter 2
# The Intel Advantage

Sun Microsystems, Inc. collaborates closely with Intel Corporation to bring to market a broad server family based on the latest Intel® Xeon® processor technology. In the Sun Fire X4170, X4270, and X4275 servers, Sun's well-known system engineering expertise combines with Intel's processor design proficiency to emphasize performance, quality, reliability, and eco-responsibility. Engineers at both companies work together to optimize system performance under the Solaris Operating System (OS) as well as under other operating environments. Looking to the future, Sun and Intel cooperate in efforts to enhance the Solaris OS, Java™ technologies, and other functionality that complements Intel Xeon processor and Sun server designs.

The Sun Fire X4170, X4270, and X4275 servers incorporate Intel Xeon Processor 5500 Series (formerly codenamed Nehalem-EP), which includes the revolutionary new QuickPath interconnect and the Nehalem microarchitecture. Each server incorporates a common motherboard populated with up to two processors, allowing the system to deliver quick response times and high throughput for performance-hungry applications. Compatible with a legacy of IA-32 software, these 64-bit processors support a large volume of existing 32-bit applications as well as emerging 64-bit applications.

This chapter introduces the new Intel Xeon processors and microarchitecture used in this Sun server family. For detailed information on these components, see the Web site sun.com/x64.

## New Intel Core Microarchitecture

With each release of a new processor series, Intel tends to alternate between enhancing the manufacturing process (shrinking the processor die) and redesigning the core microarchitecture. Over a year ago, Intel transitioned to a 45nm manufacturing process that enabled smaller transistors, allowing the previous processor generation to consume less power, achieve faster switching times, and provide greater on-die density than the generation before. This year, Intel is introducing a totally new microarchitecture design (codenamed "Nehalem") in the Intel Xeon Processor 5500 Series — at the same time reaping the benefits from its previous expertise with 45nm silicon manufacturing.

This new Intel Xeon processor generation is targeted at delivering optimal performance for bandwidth-intensive, threaded applications, with a microarchitecture that features significant innovations over previous designs:

- *Intel® QuickPath technology.* This new technology provides a high-speed, point-to-point interconnect between processors, memory, and I/O. The Intel QuickPath interconnect (QPI) links processors in a distributed shared memory design that

enables high bandwidth and low latency memory access. Because it is a point-to-point interconnect, processors do not contend for a single bus when accessing memory and I/O, and do not compete for bus bandwidth, which enhances scalability. Each QPI port includes two unidirectional links that support from 4.8 up to 6.4 GT/s per link, enabling up to 12.8 GB/s bandwidth in each direction for a total bandwidth of 25.6 GB/s — significantly higher than previous bus designs.

- *Multiple processor cores.* The microarchitecture design scales from 2 to 8 cores per die, with four cores in the Intel Xeon Processor 5500 Series.
- *Integrated DDR3 memory controller.* Implemented as a separate component in earlier architectures, the memory controller is now integrated on the processor die. The processor design creates a Non-Uniform Memory Access (NUMA)-style memory architecture since each processor in multi-socketed systems can access local memory (connected to the local memory controller) as well as remote memory connected to the second processor.

  In addition to independent channel mode operation in which each memory channel supports direct memory access, the integrated memory controller also supports the following two modes:

  - *Memory channel mode* increases reliability through memory mirroring. In this mode, two memory channels operate as mirrors of each other. The same content is written to both channels simultaneously, creating data redundancy. As a consequence of mirroring, the amount of usable system memory reduces to half of the total physical memory installed. To use memory channel mode, both channels must be populated with identical DIMM types.
  - *Lockstep channel mode* operates two memory channels in lockstep, increasing the reliability of each memory operation. In this mode, the cache line is split across two channels, both channels must be populated identically, and memory mirroring and sparing are not supported.

  Regardless of the mode in use, the integrated memory controller also increases data protection through support for demand and patrol scrubbing and single device data correction (SDDC).

  - *Demand and patrol scrubbing* technology proactively searches system memory, repairing correctable errors. In the case of uncorrectable errors, the algorithm permanently marks the memory location as unreadable.
  - *x4 and x8 SDDC* offers an advanced form of ECC technology that protects computer memory systems from any single memory chip failure. This technology can detect and correct 1-bit to 4-bit internal data and data pin failures within one DDR memory device, and detect up to 8-bit internal data and data pin failures within two DDR memory devices. SDDC performs this function by scattering the bits of an ECC word across multiple memory chips, such that the failure of any one memory chip affects only one ECC bit. (Note: x8 SDDC is only available in lockstep channel mode)

- *Advanced cache model.* Each core has an associated Level-1 (L1) instruction/data cache (64KB per core) and a large integrated Level-2 (L2) cache (256KB per core). Also, all cores on a die share access to an inclusive Level-3 (L3) cache. The L3 cache varies in size from four to eight MB, depending on the specific processor model.
- *Extended SSE4 (Streaming SIMD Extensions).* These processor extensions improve performance for XML, string, and text processing.
- *Virtualization enhancements.* Embedded virtualization technologies enable hardware-based assistance for I/O device virtualization, improved virtualization efficiency, and enhanced connectivity within a virtualized server.
- *Intel® HyperThreading (HT) technology.* This technology provides multiple virtual threads per core, increasing performance for highly threaded applications. In the Sun Fire X4170, X4270, and X4275 servers, Intel Xeon Processor 5500 Series implement two threads per core.
- *Intel® Turbo Boost Technology.* For both multi-threaded and single-threaded workloads, this technology increases performance by taking advantage of processor and system power along with thermal headroom. The Turbo Boost feature can increase performance up to two or three speed bins (266 or 400 MHz) above typical performance levels. Turbo Boost and HyperThreading capabilities vary according to specific processor models.
- *Intel® Intelligent Power Technology.* When a processor workload decreases, unneeded components — cores, cache and memory — are put into sleep mode to reduce power consumption.

Figure 2 depicts the microarchitecture of the Intel Xeon Processor 5500 Series.

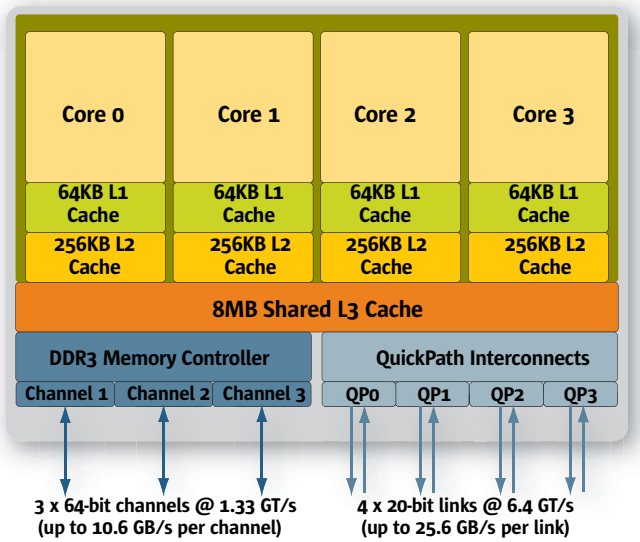


*Figure 2. Intel Xeon Processor 5500 Series*

## Modular architecture

The New Intel Core Microarchitecture (codenamed Nehalem) is extremely modular, allowing a range of implementations to meet a variety of application needs and price points. The diversity between processor types (Table 2) results from differentiation in the number of cores, the size of the on-die L3 cache, the speed of QPI links, and maximum speed to memory, as well as support for Turbo Boost mode and HyperThreading functionality.

*Table 2. DIfferentiation between microarchitecture implementations.*

| Processor type | Number of cores | L3 cache | QPI link speed | Max memory speed | Turbo Boost bins | Hyper Threading |
|---|---|---|---|---|---|---|
| Performance | 4 | 8MB | 6.4 GT/s | 1333 MT/s | 3 | yes |
| Volume | 4 | 8MB | 5.86 GT/s | 1066 MT/s | 2 | yes |
| Value | 2-4 | 4MB | 4.8 GT/s | 800 MT/s | N/A | no |

The Sun Fire X4170, X4270, and X4275 servers are available with processors from the “performance” or “volume” processor class. Processors in these servers feature four cores, 8 MB of shared L3 cache, and Turbo Boost and HyperThreading capabilities.

## Power management technologies

Continuing the trend of reducing the processor energy footprint, Intel has designed a microarchitecture that facilitates high performance while minimizing power consumption. Enhancements to the microarchitecture add a greater number of CPU power states and decrease latency when a core switches from one state to another. In fact, the Intel Xeon Processor 5500 Series has up to 15 operating states, offers a two microsecond state-to-state transition latency, and reduces CPU idle power to 10 watts. Power gates that reside on the die allow idle cores to go to a near-zero power state independently of one another.

To further conserve energy, memory, QPI, and PCI Express circuitry can also transition to lower power states. Using DIMM self-refresh, DIMMs are automatically idled when all CPU cores in the system are idle. DIMM Clock Enable (CKE) automatically places idle DIMMs into a lower power state. QPI links and PCI Express lanes are also placed in reduced power states during periods of inactivity.

The processor design helps to conserve power use, which can directly translate into energy savings and reduced operational costs. Table 3 lists typical power envelopes for Intel Xeon Processor 5500 Series configurable in the Sun Fire X4170, X4270, and X4275 servers (these are the processor models available as of this writing). Because of innovative power efficiencies in the microarchitecture, even the highest speed processors in the Intel Xeon Processor 5500 Series have a power envelope of only 95W — in comparison to the previous generation of high-speed processors which exhibited a power envelope as high as 120W.

*Table 3. Power envelopes for Intel Xeon Processor 5500 Series in Sun Fire X4170, X4270, and X4275 servers*

| Processor | Processor speed | QPI link speed | Power |
|---|---|---|---|
| Intel Xeon X5570 | 2.93 GHz | 6.4 GT/s | 95W |
| Intel Xeon X5560 | 2.80 GHz | 6.4 GT/s | 95W |
| Intel Xeon E5540 | 2.53 GHz | 5.86 GT/s | 80W |
| Intel Xeon L5520 | 2.26 GHz | 5.86 GT/s | 60W |
| Intel Xeon E5520 | 2.26 GHz | 5.86 GT/s | 80W |

## Intel Xeon Processor 5500 platform

The Sun Fire X4170, X4270, and X4275 servers share the same motherboard and thus the same Intel Xeon 5500 Series Platform (codenamed Tylersburg-EP). Up to two processors interface to each other and to the Intel 5520 I/O Handler (IOH) over multiple Intel QuickPath technology interconnects. The IOH (codenamed Tylersburg-36D) interfaces to an Intel 82801JR I/O Controller Hub (ICH10R), enabling expandability and high I/O throughput. Each Intel Xeon Series Platform is designed to match processor performance with memory capacity, I/O expandability, and interconnect bandwidth. Chapter 3 includes system block diagrams and descriptions.

For more information on the Intel Xeon Processor 5500 Series and the related platform, see sun.com/x64.

Chapter 3

# Sun Fire X4170, X4270, and X4275 Server Architectures

The Sun Fire X4170, X4270, and X4275 servers are designed to provide best-in-class performance with unprecedented expandability and low power consumption. This chapter details physical and architectural aspects of the systems, highlighting similarities and differences between the server designs.

The three server models share a common motherboard architecture — up to two Intel Xeon Processor 5500 Series connect to an Intel 5520 I/O Handler (IOH) over multiple Intel QuickPath technology interconnects. The IOH provides PCI 2.0 expandability and interfaces to an Intel 82801JR I/O Controller Hub (ICH10R). Details about server subsystems (chipsets, memory subsystems, I/O subsystems, etc.) are given later in this chapter.

## Sun Fire X4170 system-level architecture

Figure 3 and Figure 4 contain system-level block diagrams for Sun Fire X4170 servers.

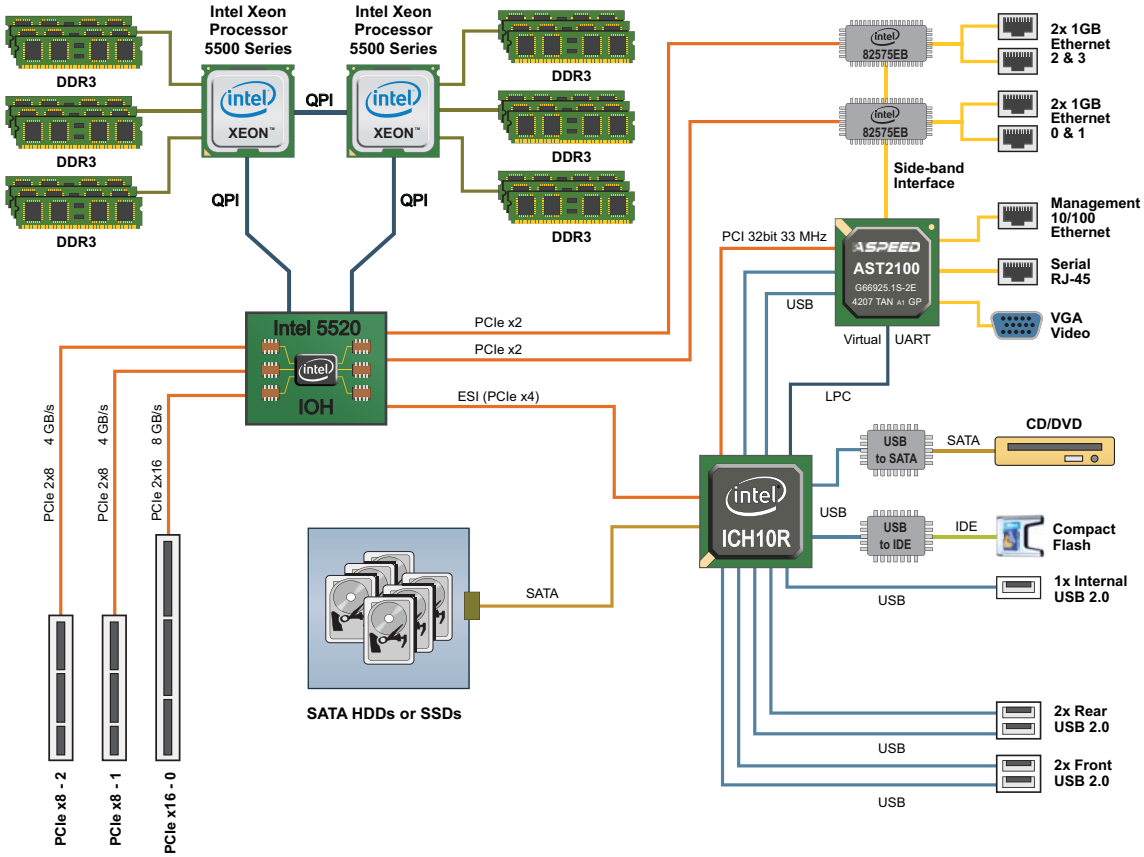


*Figure 3. Block diagram of Sun Fire X4170 server using internal controller to connect SATA devices*

Figure 3 shows a direct connection for up to six SATA HDDs or four SATA SSDs from the ICH10R, which features an integrated SATA-II disk controller. Figure 4 depicts a configuration with a SAS HBA card that supports up to eight internal SAS or SATA HDDs or four internal SATA SSDs. Note that RAID configurations are supported only through the use of the PCIe SAS HBA card as shown in Figure 4.

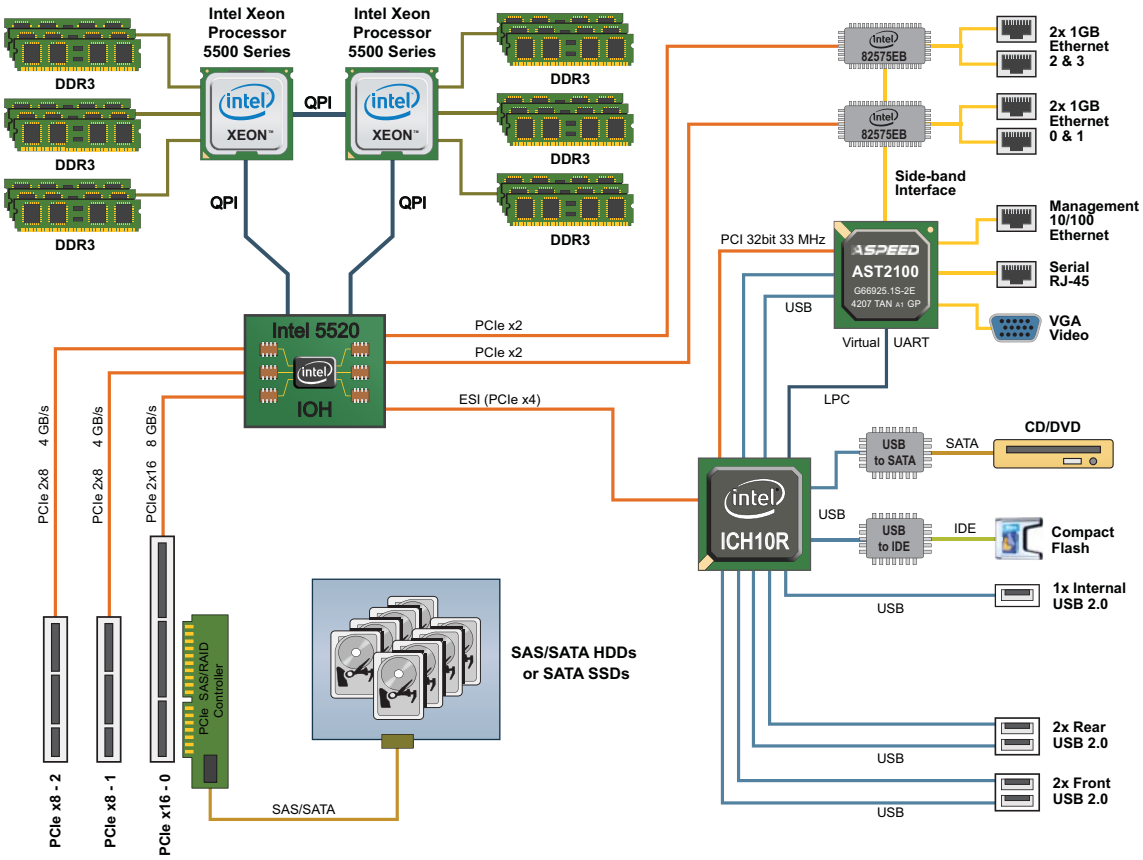


*Figure 4. Block diagram of Sun Fire X4170 server with a SAS HBA*

## Sun Fire X4170 server overview

The Sun Fire X4170 server includes the following major components:

- One or two Intel Xeon Processor 5500 Series
- Up to 144 GB of memory (using 8 GB RDIMMs) populated in 18 Registered Dual Inline Memory Module (RDIMM) slots — 2 GB, 4 GB, or 8 GB RDIMMs are supported (8GB RDIMMs will be available shortly after initial platform availability)
- Four on-board 10/100/1000 Mbps Ethernet ports
- Three low-profile PCIe 2.0 slots, one 16-lane and two 8-lane
- Up to eight internal 2.5-inch SAS/SATA HDDs or four SATA SSDs (with a SAS HBA) or six 2.5-inch SATA HDDs or four SSDs (without a SAS HBA card)
- Five USB 2.0 ports

- An on-board ILOM service processor
- Up to two hot-swappable, high-efficiency power supply units (PSUs) for N+1 redundancy
- Seven hot-swappable, variable speed fan modules (for N+1 redundancy), each containing two fans operating under environmental monitoring

## Sun Fire X4170 server enclosure

The Sun Fire X4170 server enclosure is designed to occupy one rack unit in a standard 19-inch rack. Table 4 gives system dimensions and weight.

*Table 4. Dimensions and weight of the Sun Fire X4170 server*

| Dimension | U.S. | International |
|---|---|---|
| Height | 1.71 inches (1 RU) | 43.43 millimeters |
| Width | 16.75 inches | 425.5 millimeters |
| Depth | 27.0 inches | 685.8 millimeters |
| Weight | 36 pounds | 16.36 kilograms maximum |

## Sun Fire X4170 server front and rear perspectives

Figure 5 illustrates the Sun Fire X4170 server's front and rear panels.

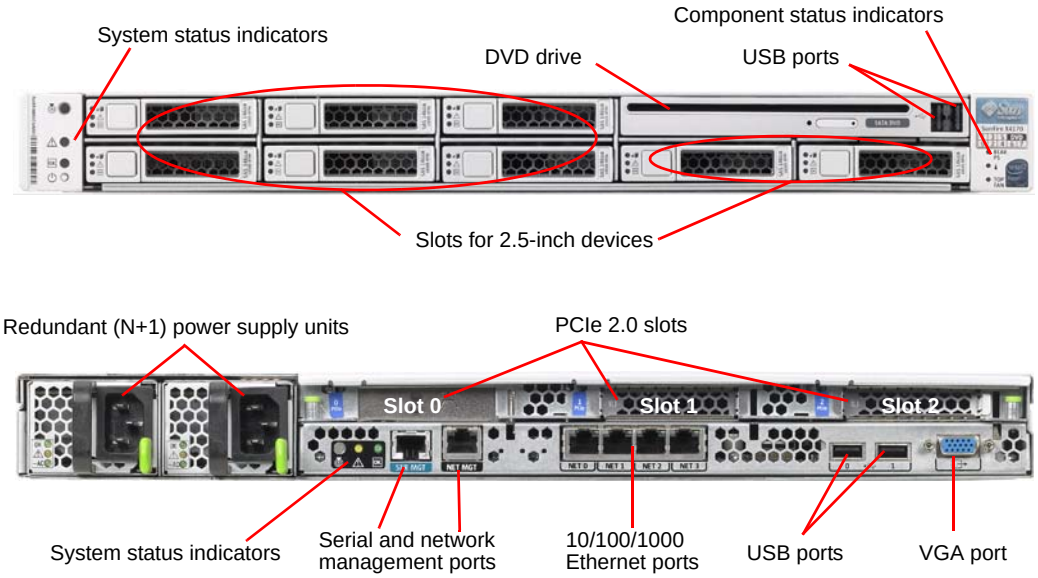


*Figure 5. Sun Fire X4170 server, front and rear panels*

External features and connections include:

- Front and rear status indicator lights, reporting “locator” (white), “service required” (amber), and “activity status” (green) for the system and components
- Up to eight 2.5-inch SAS/SATA HDDs or four SATA SSDs (using a SAS HBA), or six 2.5-inch SATA HDDs or four SATA SSDs (using the on-board controller) — all HDD or SSD devices insert through the front panel
- One slimline, slot-accessible SATA DVD-RW, accessible through the front panel
- Five USB ports — two on the front panel, two on the rear panel, and one internal (to attach internal boot devices)
- Up to two power supply units (for N+1 redundancy) with integrated fans, with each power supply having a single, independent AC plug on the rear panel
- Rear power-supply indicator lights, showing the status of each hot-swappable power supply
- Four 10/100/1000BaseT autosensing Ethernet ports, accessible on the rear panel
- Three PCIe 2.0 slots, in which low-profile cards can be installed from the rear panel
- Two management ports on the rear panel (one 10/100BaseT Ethernet port and one RJ-45 serial port) for default connections to the service processor. Any one of the four on-board Ethernet ports can also be configured as a system management port.
- VGA video port with an analog HD-15 VGA connector on the rear panel

## Sun Fire X4270 system-level architecture

Figure 6 contains a system-level block diagram for the Sun Fire X4270 server. A PCIe SAS HBA card is used to support internal 2.5-inch SAS or SATA storage devices, and connects to the SAS expander on the disk backplane. (The SAS expander cannot connect to the ICH10R on-board disk controller as that controller is SATA II only.) Any Sun Fire X4270 server with internal drives must have a SAS HBA regardless of type of drives.

The Sun Fire X4270 server supports up to 16 internal SAS/SATA HDDs or up to eight internal SATA SSDs, all in a 2.5-inch form factor. Since SSD devices require full power at system initialization, the initial power-on surge limits the number of 32GB SSD devices to a maximum of eight in the Sun Fire X4270 server. The remaining eight drive slots can be populated with SAS HDDs, if desired.

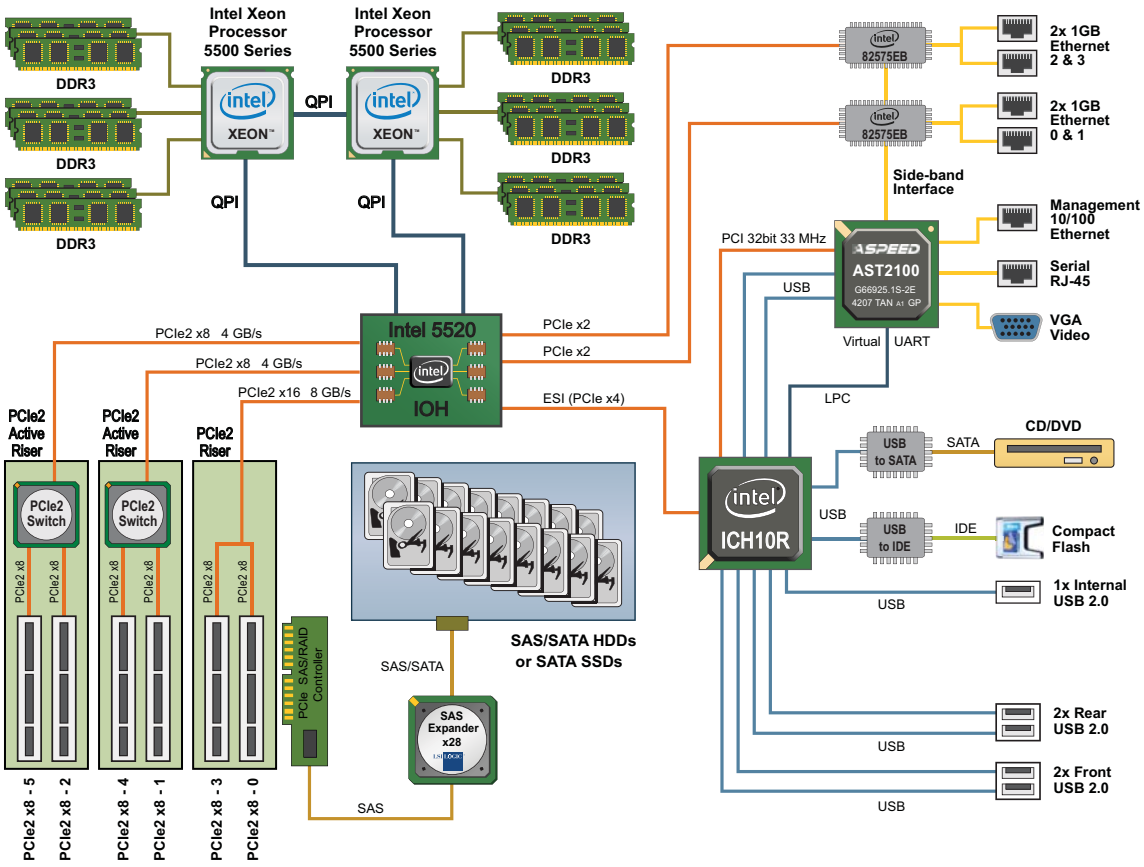


*Figure 6. Block diagram of Sun Fire X4270 server with SAS HBA*

## Sun Fire X4270 server overview

The Sun Fire X4270 server includes the following major components:

- One or two Intel Xeon Processor 5500 Series
- Up to 144 GB of memory (using 8 GB RDIMMs) populated in 18 RDIMM slots — 2 GB, 4 GB, or 8 GB RDIMMs are supported (8GB RDIMMs will be available shortly after initial platform availability)
- Up to sixteen internal 2.5-inch SAS/SATA HDDs or up to eight 2.5-inch SATA SSDs (using a PCIe SAS HBA)
- Four on-board 10/100/1000 Mbps Ethernet ports
- Six low-profile PCIe 2.0 slots, all 8-lane
- Five USB 2.0 ports
- An on-board ILOM service processor
- Up to two hot-swappable, high-efficiency power supply units (PSUs) for N+1 redundancy
- Six hot-swappable, variable speed fan modules (for N+1 redundancy), each with two fans operating under environmental monitoring and control

### Sun Fire X4270 server enclosure

The Sun Fire X4270 server enclosure is designed to occupy two rack units in a standard 19-inch rack (Table 5).

*Table 5. Dimensions and weight of the Sun Fire X4270 server*

| Dimension | U.S. | International |
|---|---|---|
| Height | 3.34 inches (2 RU) | 84.84 millimeters |
| Width | 16.75 inches | 425.5 millimeters |
| Depth | 27 inches | 685.8 millimeters |
| Weight | 49.00 pounds | 22.27 kilograms |

## Sun Fire X4270 server front and rear perspectives

Figure 7 illustrates the front and rear panels of the Sun Fire X4270 server.

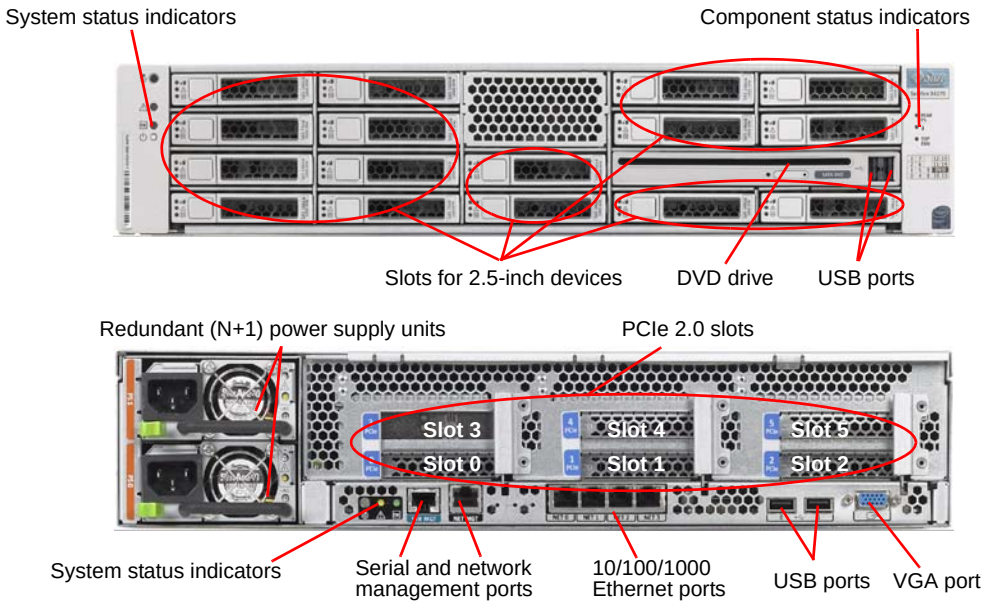


*Figure 7. Sun Fire X4270 server, front and rear panels*

External features and connections include:

- Front and rear status indicator lights, reporting “locator” (white), “service required” (amber), and “activity status” (green) for the system and components
- Up to 16 2.5-inch SAS/SATA HDDs or up to eight 2.5-inch SATA SSDs, which insert through the front panel and interface to a PCIe SAS HBA card
- One slimline, slot-accessible SATA DVD-RW, accessible through the front panel
- Five USB ports — two on the front panel, two on the rear panel, and one internal (to attach internal boot devices)
- Up to two power supply units (for N+1 redundancy) with integrated fans, with each power supply having a single, independent AC plug on the rear panel
- Rear power-supply indicator lights, showing the status of each hot-swappable power supply
- Four 10/100/1000BaseT autosensing Ethernet ports, accessible on the rear panel
- Six PCIe 2.0 slots, in which low-profile cards can be installed from the rear panel
- Two management ports on the rear panel (one 10/100BaseT Ethernet port and one RJ-45 serial port) for default connections to the service processor. Any one of the four on-board Ethernet ports can also be configured as a system management port.
- VGA video port with an analog HD-15 VGA connector on the rear panel

## Sun Fire X4275 system-level architecture

Figure 8 contains a system-level block diagram for the Sun Fire X4275 server. Because of its new 2U chassis and disk enclosure design, this server can support 3.5-inch storage devices using a PCIe SAS HBA card. The PCIe SAS HBA card connects to a SAS expander on the disk backplane. (The SAS expander cannot connect to the ICH10R on-board disk controller as that controller is SATA II only.) Any Sun Fire X4275 server with internal drives must have a SAS HBA regardless of type of drives.

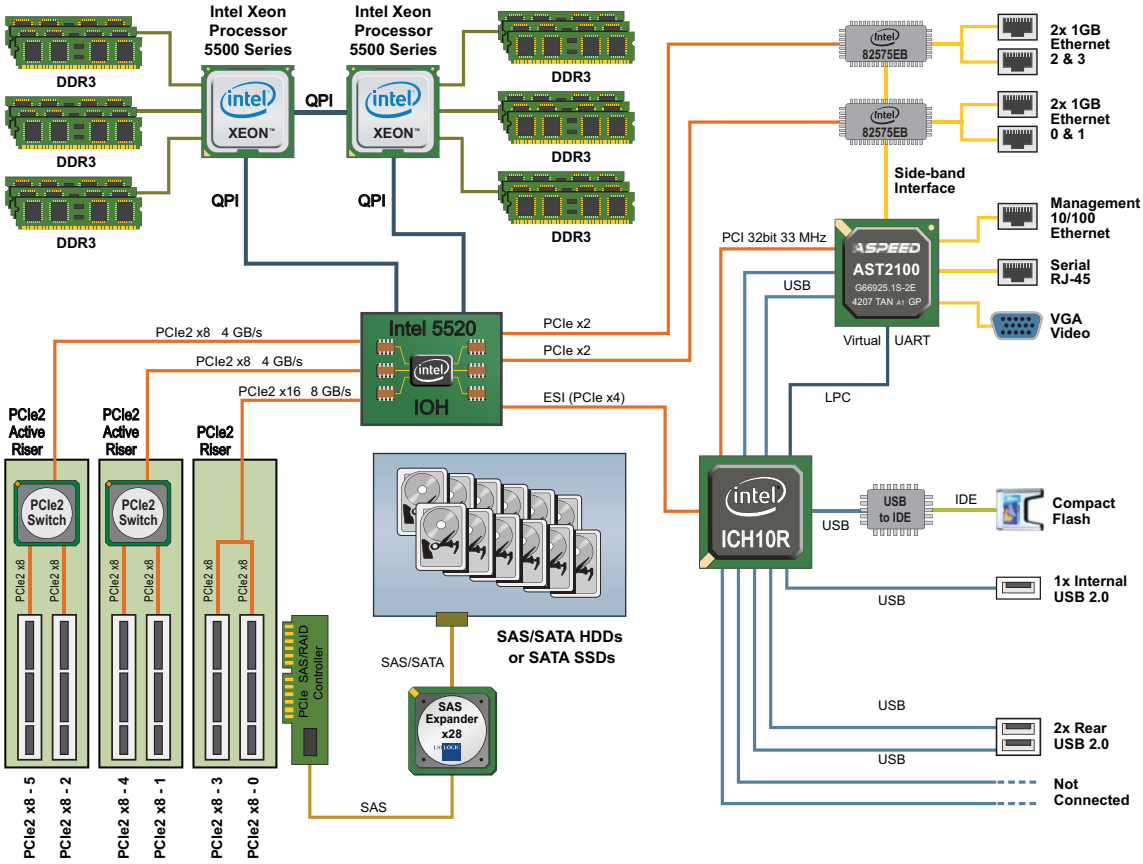


*Figure 8. Block diagram of Sun Fire X4275 Server with SAS HBA*

The Sun Fire X4275 server supports up to 12 internal SAS/SATA HDDs or up to eight internal SATA SSDs that use a 3.5-inch form factor. Since SSD devices require full power at system initialization, the initial power-on surge limits the number of 32GB SSD devices to a maximum of eight SSDs. If desired, the remaining four drive slots can be populated with SAS HDDs.

## Sun Fire X4275 server overview

The Sun Fire X4275 server includes the following major components:

- One or two Intel Xeon Processor 5500 Series
- Up to 144 GB of memory (using 8 GB RDIMMs) populated in 18 RDIMM slots — 2 GB, 4 GB, or 8 GB RDIMMs are supported (8GB RDIMMs will be available shortly after initial platform availability)
- Up to 12 internal 3.5-inch SAS/SATA HDDs or eight SATA SSDs (using a PCIe SAS HBA)
- Four on-board 10/100/1000 Mbps Ethernet ports
- Six low-profile PCIe 2.0 slots, all 8-lane
- Three USB 2.0 ports
- An on-board ILOM service processor
- Up to two hot-swappable, high-efficiency power supply units (PSUs) for N+1 redundancy
- Six hot-swappable, variable speed fan modules (for N+1 redundancy), each with two fans operating under environmental monitoring and control

### Sun Fire X4275 server enclosure

The Sun Fire X4275 server enclosure occupies two rack units in the new Sun-designed 19-inch rack (Table 6).

*Table 6. Dimensions and weight of the Sun Fire X4275 server*

| Dimension | U.S. | International |
|---|---|---|
| Height | 3.45 inches (2 RU) | 87.6 millimeters |
| Width | 17.19 inches | 436.5 millimeters |
| Depth | 30 inches | 762.0 millimeters |
| Weight | 65 pounds maximum | 29.54 kilograms |

## Sun Fire X4275 server front and rear perspectives

Figure 9 illustrates the front and rear panels of the Sun Fire X4275 server

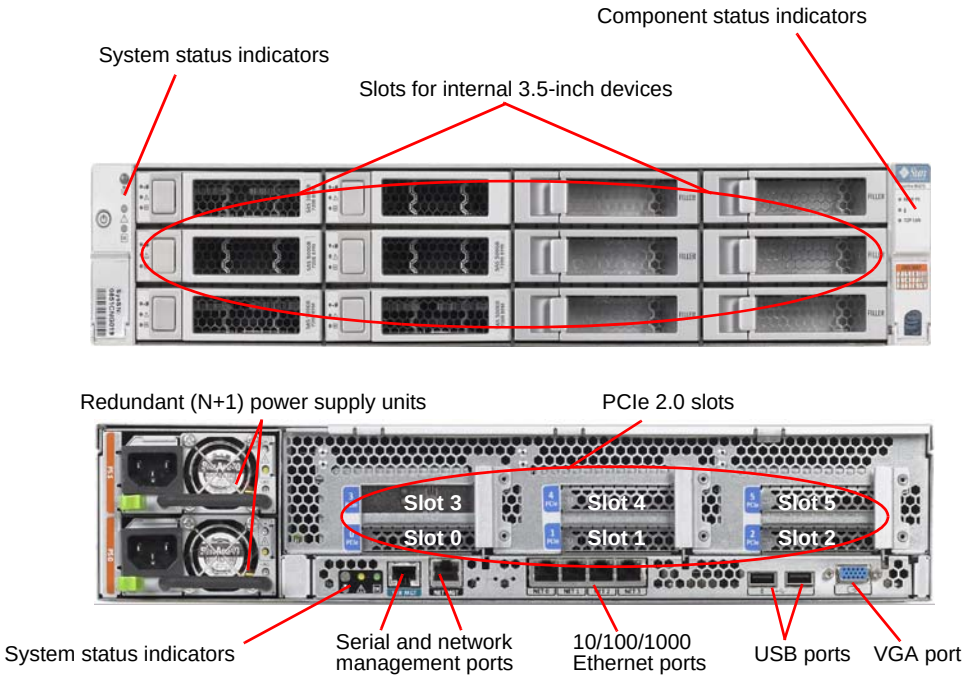


*Figure 9. Sun Fire X4275 server, front and rear panels*

External features include:

- Front and rear status indicator lights, reporting “locator” (white), “service required” (amber), and “activity status” (green) for the system and components
- Up to 12 3.5-inch SAS/SATA HDDs or eight SATA SSDs, which insert through the front panel and interface to a PCIe SAS HBA card
- Three USB ports — two on the rear panel and one internal (to attach internal boot devices)
- Up to two power supply units (for N+1 redundancy) with integrated fans, with each power supply having a single, independent AC plug on the rear panel
- Rear power-supply indicator lights, showing the status of each hot-swappable power supply
- Four 10/100/1000BaseT autosensing Ethernet ports, accessible on the rear panel
- Six PCIe 2.0 slots, in which low-profile cards can be installed from the rear panel
- Two management ports on the rear panel (one 10/100BaseT Ethernet port and one RJ-45 serial port) for default connections to the service processor. Any one of the four on-board Ethernet ports can also be configured as the management port.
- VGA video port with an analog HD-15 VGA connector on the rear panel

## System platform

Refer back to the block diagrams earlier in this chapter. The Sun Fire X4170, X4270, and X4275 servers are based on the Intel Xeon Processor 5500 Series platform, which includes:

- *Intel Xeon Processor 5500 Series.* The Sun Fire X4170, X4270, and X4275 server motherboard includes two processor sockets. (Chapter 2 describes the processor microarchitecture.)
- *An Intel 5520 I/O Handler (IOH).* The IOH (codenamed Tylersburg-36D) features two QuickPath interconnects and 36 PCIe 2.0 lanes. Of the 36 PCIe 2.0 lanes, 32 connect to PCIe risers to enable PCIe 2.0 expandability. The remaining four lanes connect to two Intel® 82575EB Gigabit Ethernet (Zoar) Controllers to support the four on-board Ethernet ports.
- *An Intel 82801JR I/O Controller Hub (ICH10R).* The ICH10R is interconnected to the IOH using one ESI (Enterprise South Bridge Interface) link. The ESI link is based on a 4-lane PCIe interconnect with proprietary extensions and offers a 2 GB/sec transfer rate. The ICH10R enables additional I/O functionality including support for system USB ports, the internal compact flash slot, and the SATA DVD/RW device (available on the Sun Fire X4170 and X4270 servers only). The ICH10R connects to the Aspeed AST2100 Service Processor using USB (for virtual devices), PCI (for video), and LPC (serial port).

For more information on the Intel Xeon Processor 5500 Series chipset, see sun.com/x64.

## Memory subsystem

The integrated memory controller and multiple DDR3 memory channels per processor help to provide high bandwidth for memory-intensive applications. DDR3 memory components offer greater density and run at higher speeds, but at significantly lower voltages than previous generation DDR2 memories. The Sun Fire X4170, X4270, and X4275 servers can be populated with DDR3 Registered ECC DIMM modules in either 2 GB, 4 GB, or 8 GB capacities. (8GB RDIMMS will be available shortly after the initial release of the servers.)

Each processor features an integrated memory controller, which means that the systems adhere to a Non-Uniform Memory Access (NUMA) memory architecture — the memory controller on one processor can access local memory as well as remote memory. The integrated memory controller supports DDR3 memories in three speeds — 800 MT/s, 1066 MT/s, and 1333 MT/s — although Sun only qualifies and offers 1066 MT/s and 1333 MT/s RDIMMs. When configuring system memory, it is important to note that DIMMs may run at slower than individually rated speeds depending on the CPU type, the number of DIMMs per channel, and the type of memory (speed, rank,

etc.). The speed at which memory is actually running is set by system BIOS at start-up, and all memory channels will run at the fastest common frequency.

## Memory population guidelines

Each processor features three memory channels. Each channel supports three RDIMM slots, enabling up to 18 RDIMMs per system in a fully populated system. Memory slots in each channel are color-coded to simplify identification:

- Blue represents slot 0
- White represents slot 1
- Black represents slot 2

As a general rule to optimize memory performance, DIMMs should be populated in sets of three, one per channel per CPU, starting with the slot furthest from the CPU socket (in slot 0, the blue slot). Ideally each channel should be populated with equal capacity DIMMs, and if possible, with the same number of identical DIMMs (which helps to make memory performance more consistent). In a server with a single processor, the DIMM slots next to the empty CPU socket should not be populated. In general, it is better to populate quad rank (QR) DIMMs first, followed by dual rank (DR) DIMMs and/or single rank (SR) DIMMs.[1]

### Optimizing memory for bandwidth

Configurations with optimal memory bandwidth can be achieved using the "Performance" class of Intel Xeon Processor 5500 Series (see Table 2 on page 10) and memory components that run at 1333MT/s. To optimize a configuration for bandwidth, populate one single rank (SR) or dual rank (DR) DDR3 1333 MT/s DIMM per channel (the use of quad rank (QR) DIMMs limits the number of DIMMs per channel to two, and restricts the maximum memory access speed to 1066 MT/s).

### Optimizing memory for capacity

If three DIMMs per channel are populated to optimize for memory capacity, the memory access speed is reduced to 800 MT/s, regardless of the type of DIMMs (1066 MT/s or 1333 MT/s,). For this reason, using 1066 MT/s DIMMs is recommended to reduce the configuration cost. With all 18 slots populated using 8GB DIMMs, it is possible to achieve a maximum system memory capacity of 144GB.

# I/O subsystem

With built-in headroom to expand systems and scale applications, the Sun Fire X4170, X4270, and X4275 servers feature expandability through a PCIe 2.0 expansion bus, internal storage options, four on-board Intel Gigabit Network Interface Controllers (NICs), and integrated USB capabilities.

1. "Rank" refers to the number of memory chips that a DIMM module has connected on any given data line. Sun offers only single rank (SR) and dual rank (DR) DIMMs at this time.

As shown in the block diagrams for the systems, the ICH10R provides connectivity for system USB ports, the internal compact flash, and the SATA DVD/RW device (available in the Sun Fire X4170 and X4270 servers only). To enable USB 2.0 functionality on the Sun Fire X4170, X4270, and X4275 servers, two USB ports go from the ICH10R to the rear panel and one USB link is routed to the internal USB port. On the Sun Fire X4170 and X4270 servers, two additional USB ports are routed from the ICH10R to the front panel.

The ICH10R drives a USB-to-IDE interface that supports an internal compact flash slot (Sun offers a 16GB compact flash device as an optional boot device). The ICH10R also includes a USB-to-SATA interface to connect the internal SATA DVD/RW drive on Sun Fire X4170 and X4270 servers.

## System network interfaces

The IOH has four PCIe lanes that interface to two Intel® 82575EB Gigabit Ethernet (Zoar) Controllers. Each controller supports two on-board 10/100/1000 Mbit/sec Ethernet ports. Multiple on-board Gigabit Ethernet connections promote flexibility and enable configurations that support network interface failover.

The four Gigabit Ethernet ports are numbered in sequence from left to right on the rear panel. Each port auto-negotiates its link connection, and LEDs above the port indicate the speed of the established link (green signifies that the established link is 1000 Mbit/sec). The Ethernet interfaces also support PXE boot for booting over the network.

A new feature in the Sun Fire X4170, X4270, and X4275 servers is the ability to configure any one of the four on-board Ethernet ports for “side-band” management. (See “ILOM Service Processor and System Management” on page 34.) When configured as a management port, one of the on-board Ethernet interfaces has two MAC addresses and requires two IP addresses (one for data and one for management).

Just like the AST2100 Service Processor on the motherboard, the two Intel 82575EB Gigabit Ethernet controllers are powered from a “stand-by” power source from system power supplies. Even when power to the server is lost or turned off, the side-band management interface remains active to allow remote management.

## PCIe 2.0 expansion bus

The Sun Fire X4170, X4270, and X4275 servers include a PCIe 2.0 expansion bus that can accommodate low-profile cards rated at 25W maximum. PCIe 2.0 doubles the interconnect bit rate, increasing the aggregated bi-directional bandwidth of a 16-lane link to approximately 16 GB/s. On each server model, three right-angle risers plug directly into the motherboard to enable PCI 2.0 expansion. Single slot 1U risers are used on the Sun Fire X4170 server versus dual-slot 2U risers on the Sun Fire X4270 and X4275 servers. Cards can be compliant with Revision 1.0a or 2.0 of the PCIe Card Electromechanical Specification, and are installed with a horizontal orientation.

On the Sun Fire X4170 server, the three PCIe 2.0 slots are numbered left to right (refer back to Figure 5). Slot 0 uses a x16 mechanical riser (Figure 10) and has 16 electrical lanes to the IOH. Slots 1 and 2 are located on x8 mechanical risers with eight electrical lanes. The risers are keyed to correctly insert into the motherboard.

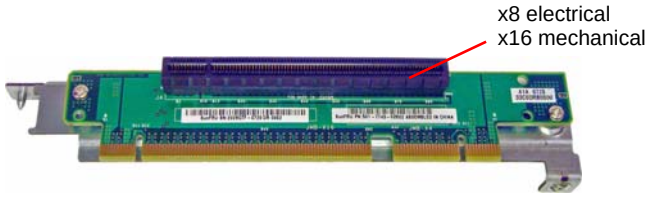


*Figure 10. PCIe 2.0 x16 riser for the 1U Sun Fire X4170 server (for Slot 0)*

The six slots on Sun Fire X4270 and X4275 servers are numbered left to right across the bottom (Slots 0 to 2) and then left to right across the top of the rear panel (Slots 3 to 5) — refer back to Figure 7 and Figure 9, which show the rear panels of the Sun Fire X4270 and X4275 servers, respectively. Both 2U servers incorporate one passive riser (for Slots 0 and 3) and two active risers (for Slots 1 and 4, and Slots 2 and 5, Figure 11). Each 2U riser supports two PCIe 2.0 slots for I/O expandability and is keyed to correctly insert into the motherboard. Each 2U riser provides two 8-lane (electrical and mechanical) slots, for a total of six x8 PCIe 2.0 slots in each 2U server.

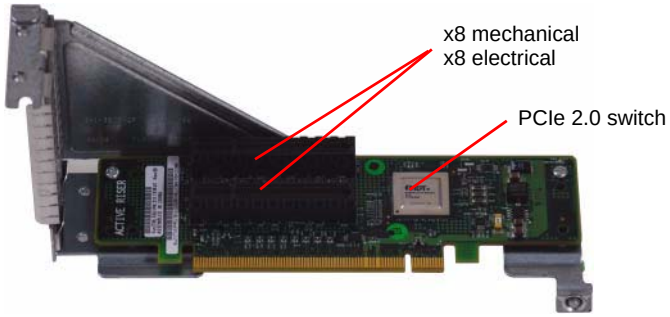


*Figure 11. PCIe 2.0 active riser for 2U Sun Fire X4270 and X4275 servers (Slots 1 & 4, and 2 & 5)*

The passive riser splits 16 PCIe 2.0 lanes from the IOH into two sets of 8 lanes, one set for each riser slot. The active riser (Figure 11) uses an IDT PES24T6G2 PCIe 2.0 switch to expand eight PCIe lanes from the IOH into two x8 slots. The PES24T6G2 switch features six ports and twenty-four 5 Gbps PCIe 2.0 lanes supporting 5 Gbps, 2.5 Gbps, and mixed 5 Gbps/2.5Gbps modes. As implemented in these servers, the switch provides high-performance I/O connectivity and switching functions between the riser's x8 PCIe 2.0 upstream port and the two x8 downstream ports. It supports eight Traffic Classes (TCs) and one Virtual Channel (VC) with sophisticated resource management algorithms (including round robin, weighted round-robin, and strict priority schemes). The switch helps to support PCIe applications that demand high throughput and low latency, such as high throughput 10 Gigabit I/O cards, SATA controllers, and Fibre Channel HBAs. However, it is not recommended to insert more than one high bandwidth and latency-

sensitive PCIe card in slots managed by a single switch at the same time (e.g., in Slots 1 and 4, or in Slots 2 and 5).

By default, Slot 0 on Sun Fire X4170, X4270, and X4275 servers is used for the host bus adapter that connects to internal SAS/SATA HDDs or SATA SSDs. On the Sun Fire X4170 server, the SAS HBA can be moved to Slot 2 if desired. On the Sun Fire X4270 and X4275 servers, it can be moved to Slots 2, 3, or 5. (On all three server models, a heat sink interferes with internal cabling to the HBA if the HBA is installed in a center PCIe 2.0 slot.)

## Integrated storage

The Sun Fire X4170, X4270, and X4275 servers offer large internal storage capacities for SAS or SATA HDDs and can also accommodate SATA SSDs. The servers differ, however, in the number and type of internal storage devices supported. Table 7 summarizes the differences.

*Table 7. Storage characteristics for Sun Fire X4170, X4270, and X4275 servers*

| Feature | Sun Fire X4170 Server | Sun Fire X4270 Server | Sun Fire X4275 Server |
|---|---|---|---|
| Number of device slots | 8 | 16 | 12 |
| Device form-factor | 2.5-inch devices | 2.5-inch devices | 3.5-inch devices |
| Maximum number of internal SAS HDDs<br>– 73 GB 15K<br>– 146 GB 10K | 8 (with PCIe SAS RAID HBA) | 16 (with PCIe SAS RAID HBA) | 12 (with PCIe SAS RAID HBA) |
| Maximum number of internal SATA HDDs | 8 SATA HDDs with PCIe SAS RAID HBA or 6 using embedded SATA controller[1, 2] | 16 (with PCIe SAS RAID HBA)[1] | 12 (with PCIe SAS RAID HBA) |
| Maximum number of internal SATA SSDs | 4 SSDs using embedded SATA controller[2, 3] | 8 (with PCIe SAS RAID HBA)[3] | 8 (with PCIe SAS RAID HBA)[3] |

1 Populating the server with SATA HDDs requires a reduction in fan speed. This means that the server can support only lower power processors (CPUs that produce 85w max in the Sun Fire X4170 server or 95w max in the Sun Fire X4270 server).
2 The on-board SATA controller provides no RAID capabilities. Use the PCIe SAS RAID HBA card to implement RAID configurations.
3 Remaining drive slots can be populated with SAS HDDs connected to a SAS HBA. In the Sun Fire X4270 or X4275 servers, an existing SAS HBA can be used for SAS HDDs; in the Sun Fire X4170 server, a SAS HBA must be installed to support SAS HDDs.

As Table 7 shows, the 1U Sun Fire X4170 server can support up to eight internal 2.5-inch HDDs, while the 2U Sun Fire X4270 server can house up to sixteen 2.5-inch internal HDDs. The Sun Fire X4275 server uses a modified 2U chassis and drive cage design that allows it to support up to twelve 3.5-inch internal HDDs.

In the Sun Fire X4170 server, the on-board SATA controller supports up to six directly attached SATA HDDs or four SATA SSDs (although these configurations do not provide any RAID capabilities)— a PCIe SAS RAID HBA card is required to fully populate all 8 slots with SATA or SAS devices and to implement RAID. In both the 2U Sun Fire X4270

and X4275 servers, the PCIe SAS RAID HBA is needed in *all* configurations to support internal storage options. Mixing SATA and SAS devices internally is supported (but not within a RAID volume).

### Available devices

The following devices are available for the Sun Fire X4170, X4270, and X4275 servers (at the time of this writing):

- SAS HDDs
  - 2.5" SAS disks: 73 GB 15K and 146 GB 10K (Note that 146 GB 15K and 300 GB 10K HDDs will be available shortly after initial server availability.)
  - 3.5" SAS disks: 300 GB 15K, 450 GB 15K
- SATA HDDs
  - 2.5" SATA disks: 500 GB 7200 RPM (shortly after initial server availability)
  - 3.5" SATA Disks: 1000 GB 7200 RPM
- SATA SSDs
  - 2.5" SFF SATA SSDs: 32 GB
  - 3.5" SATA SSDs (2.5" SSD in 3.5" carrier with bracket adapter): 32 GB

To support SATA disk drives in these servers, Sun incorporates an innovative bracket design that integrates dampening material to cushion the drive and minimize vibration.

### Solid state drives (SSDs)

Modern servers are driving throughput levels that rapidly outpace the throughput capabilities of typical storage solutions. While many servers can achieve processing capabilities in excess of one million I/O operations Per Second (IOPS), today's fastest hard disk drives are only capable of about 300 to 400 IOPS. To match throughput more closely to server performance and meet the challenging demands of data-intensive applications, many datacenters implement large pools of high-speed disk drives. In some cases, a large buffer of expensive DRAM is also deployed so that the application's working set can be stored in memory to reduce latency.

Flash technology provides a more economical alternative that can dramatically enhance application I/O performance while also operating with significantly better energy efficiency than conventional rotational hard disk drives (HDDs). The Sun Fire X4170, X4270, and X4275 servers support flash technology in the form of solid state drives (SSDs).

Recent advances in the quality of flash technology have made SSDs an effective and reliable solution for enterprise storage, enabling a new strategy for implementing tiered storage solutions. Because SSDs offer low latency, they fall into a cost and performance sweet spot between mechanical drives and DRAM and thus can provide tremendous value in conjunction with I/O-intensive workloads. SSDs use a drive form factor and are directly inserted into drive bays specific to the Sun Fire X4170, X4270, and

X4275 servers. The servers' operating system and BIOS views SSDs as standard SATA drives.

Unlike rotational media, which spins up slowly at power-on, SSD devices require full power at system initialization. Because of this initial power-on surge, there are some limitations with the number of 32GB SSD devices initially supported in the Sun Fire X4170, X4270, and X4275 servers. The Sun Fire X4170 server can support a maximum of four SATA SSDs, while the Sun Fire X4270 and X4275 servers can support a maximum of eight SSD devices. For configurations that incorporate a SAS HBA, it is possible, however, to populate remaining empty device slots with SAS HDDs.

### Optimizing performance using SSDs

Taking advantage of the performance and cost characteristics of an SSD requires an enabling technology that can transparently use it to drive better application and file system performance. Solaris ZFS allows datacenter architects to balance performance requirements against cost by using a variety of device types to store, archive, and access information. Creating a Hybrid Storage Pool in Solaris ZFS leverages the strengths of both rotational and solid state storage media. A Hybrid Storage Pool automatically places data on the most appropriate storage media to optimize performance and manage costs, and the ZFS file system can transparently cache data on SSDs without any need to modify applications. ZFS recognizes different media types and optimizes data placement to maximize system throughput. (For more information, see the solution brief "Solaris ZFS Enables Hybrid Storage Pools — Shatters Economic and Performance Barriers," available at www.sun.com/software/solaris/pdf/solariszfs_solutionbrief.pdf).

### Sun Flash Analyzer

To simplify the adoption of flash technology, the Sun Flash Analyzer tool can be used to detect I/O-intensive applications that can best benefit from the performance advantages of using flash technology. The Sun Flash Analyzer tool runs on the Solaris OS, Microsoft Windows, and Linux operating environments and can be downloaded from sun.com/flash/resources.

For more information on flash technology in Sun products, see sun.com/flash.

### Drive cage design

The ample storage density of the Sun Fire X4170, X4270, and X4275 servers is partly due to innovative drive carrier designs that facilitate effective air flow above and below each drive. Drives insert into a modular disk tray and cable-free disk backplane that increases reliability and serviceability. The carrier includes an ejection handle that simplifies drive removal — drives are hot-pluggable when disk mirroring is configured. Drive status lights indicate "Ready to remove", "Fault", and "Status".

In all three systems, the disks plug into a server-specific backplane board. In the Sun Fire X4270 and X4275 servers, a 28-port LSI SAS expander (the LSISASX28) facilitates large internal storage capacities. On the Sun Fire X4270 server, eight ports on the SAS expander connect to the SAS HBA, supporting switched connections for up to 16 SAS or SATA devices. On the Sun Fire X4275 server, six ports on the SAS expander connect to the HBA to support switched connections to up to 12 3.5-inch SAS or SATA devices.

Sun engineers modified the chassis of the Sun Fire X4275 server specifically to accommodate support for larger 3.5-inch internal storage devices. On the Sun Fire X4275 server, the SAS expander is located on a daughtercard (whereas it resides directly on the backplane in the 2U Sun Fire X4270 server). Also, the drive cage in the Sun Fire X4275 server is not removable. To minimize drive vibration for 3.5-inch devices, Sun added dampening material to the Sun Fire X4275 server drive cage and designed the fan deck with a floating spring mechanism that helps to isolate fan vibration.

### Disk Controller and I/O RAID Options

The Sun Fire X4170, X4270, and X4275 servers support the following options for disk controllers:

- Embedded SATA II controller on the motherboard (Sun Fire X4170 server only). This controller supports up to six internal SATA HDDs or four SSDs (but it does not include any RAID support).
- Sun StorageTek SAS HBA based on LSI chipset. A low-profile card, the external version of this controller offers no RAID support and has two external 4-port SFF-8088 connectors. The internal version of this HBA has two internal 4-port SFF-8087 connectors and enables hardware RAID levels 0, 1, or 10.
- Sun StorageTek SAS RAID HBA, which supports 3 GB/sec SAS and hardware RAID levels 0, 1, 1E, 5, 5EE, 6, 10, 50, and 60. Based on Adaptec and Intel technology, this HBA is an 8-channel, low-profile card with two 4-port SFF-8087 connectors. The card is available in two versions: one with internal connectors and one with external connectors. This HBA includes 256 MB of DDR2 memory on-board and a battery-backed write cache for 72-hour backup, which helps to deliver protected, high availability storage.

Two cables with four lanes (each at 3 Gb/sec) each are wired from the SAS adapter to the disk backplane to control the internal HDD and SSD drives and provide high bandwidth. For the Sun Fire X4170 server, the four SAS links from the HBA connect directly to the SAS/SATA devices. In the case of the Sun Fire X4270 or X4275 server, the four SAS links connect to the LSISASX28 SAS expander. The SAS expander then provides connections to individual disks in the drive cage.

### DVD/USB Assembly

A slim form-factor SATA DVD/RW assembly is available as an option to the Sun Fire X4170 and X4270 servers. The assembly provides an internal DVD-RW device as well as two USB ports accessible from the front panel. A locking handle allows the assembly to be safely secured and more easily extracted from the system chassis. Sun Fire X4170 and X4270 servers can also be ordered with an assembly that features two USB ports only (and no DVD device). (Note that EIDE DVD devices used in previous servers are not supported in the Sun Fire X4170 and X4270 servers since the new systems are designed for a SATA DVD device. The new SATA DVD devices are clearly labeled “SATA” on the device’s exterior.)

## Enclosure features

The Sun Fire X4170, X4270, and X4275 servers feature innovative chassis designs engineered to conserve system power and reduce cooling. The power and cooling efficiency of these systems exceeds that of many competitive systems configured with similar processing, memory, and storage capacities. The effective front-to-back airflow design helps to lower component temperatures, reducing the number of fans needed to cool the system. Processors also consume less energy under cooler temperatures, and lower component temperatures help to increase overall reliability.

Key enclosure features include:

- Hex-shaped, honeycombed air inlet holes that enhance airflow and provide EMI shielding
- Front-mounted fans (located directly behind the disk drive cage) that pull air through the chassis, over system components, and exhaust it out the rear panel
- Innovative disk drive bracket design that enables efficient air flow above and below drive units
- Cable and component placement that helps to optimize cooling efficiency by channeling airflow effectively, as well as the reduction of internal cables to enhance airflow
- Fewer DC-to-DC conversions to improve power efficiency and generate less heat

### Power distribution

Engineered for high availability as well as low energy consumption, the Sun Fire X4170, X4270, and X4275 servers can be configured with two highly-efficient, redundant, hot-swappable AC/DC power supply units (PSUs), each with separate power cords. Configuring a system with a second power supply enables N+1 redundancy, supplying continuous power to the system if a single power supply fails.

The PSUs differ between systems — the Sun Fire X4170 server uses 760W PSUs while the Sun Fire X4270 and X4275 servers require 1050W PSUs. As shown in Table 8, the

power supplies are highly efficient, with an efficiency rating of at least 85% at 100% load. Sun makes available a Power Calculator on each Web site for the Sun Fire X4170, X4270, and X4275 servers (www.sun.com/x4170/, www.sun.com/x4270/, www.sun.com/x4275/). This tool allows customers to estimate power consumption under SPECjbb2005 test workloads, from idle up to 100% load.

*Table 8. Power supply unit comparison*

| System | Maximum output power | Maximum AC input current | Power supply efficiency |
|---|---|---|---|
| Sun Fire X4170 Server | 760W | At 100VAC and 760W output: 9.0A | At 760W (100%) load: 87% |
| Sun Fire X4270 and X4275 Servers | 1050W | At 100VAC and 1050W output: 12.4A | At 1050W (100%) load: 85% |

Each PSU features a non-removable internal fan that supplies independent PSU cooling. Three light indicators display power supply status information ("AC", "Fault", and "OK").

The Sun Fire X4170, X4270, and X4275 servers use a Power Distribution Board (PDB) that provides connections between the power supplies and major system components. The PDB contains a single 10Amp 12V-to-5V DC-to-DC supply used to power the disk subsystem and the optional DVD-RW device.

## Fan assemblies

The server enclosures are designed for efficient front-to-back air flow. Variable speed fans run under the control of the on-board Service Processor, which monitors processor temperatures and system ambient air temperature. Based on these readings, the fans operate at the lowest speeds possible to provide sufficient cooling — conserving power usage, prolonging fan life, and reducing acoustical noise.

Fan assemblies differ between the Sun Fire X4170, X4270, and X4275 servers. The Sun Fire X4170 server houses seven fan modules, with each module containing two 40mm, 10,000 RPM fans. In the Sun Fire X4270 and X4275 servers, there are six fan modules, with each module accommodating two hot-swappable 60mm fans.

A green status light on a fan module indicates proper operation while an amber light indicates a fan fault. Fan modules on these systems are designed for redundancy — a backup fan enables system continuity in the event of a fan failure. The fans are also hot-swappable such that a module with a failed fan can be removed and a new fan module inserted without shutting down the system. On the top of the chassis, a fan access door allows the fans to be serviced while only partially pulling the chassis out of the rack. This simplifies cable management during fan replacement.

## Rack mounting

To shorten time-to-deployment, the Sun Customer Ready Systems program can pre-install Sun Fire X4170, X4270, and X4275 servers in a rack configuration. Alternatively, these 1U and 2U servers can be field-installed into Sun or other third-party racks that meet rack-mounting requirements.

The Sun Fire X4170 and X4270 servers can be mounted in these racks:

- Third Party ANSI/EIA-310-D-1992 or IEC 60927-compliant racks in 19-inch/482.6mm panel-width series
- Sun Rack 938
- Sun Rack 1038 and 1042
- Sun Rack II 1042 and 1242

The Sun Fire X4275 server can be rack-mounted in the Sun Rack II 1242. It can also be rack-mounted in the Sun Rack II 1042 (with some limitations due to the depth of the chassis, particularly when using the cable management arm — see the documentation for more details). As a part of its redesigned chassis, the Sun Fire X4275 server features new slide rail release levers (refer back to Figure 9). Pulling down on these levers unlocks the rails' sliding mechanism, allowing the chassis to be pulled out of the rack for easier servicing.

The following options are available to simplify rack mounting:

- Rack-Mounting Slide Rail Kit. This is a 4-point mounted slide rail kit (i.e., mounting points are located at the rack front and rear).
- Tool-less Rack Kit. As the name implies, this rack-mounting kit snaps into certain Sun and third-party racks without requiring any tools.
- Cable Management Arm. The cable management arm supports and protects cables as the server slides in and out of the rack.

The Slide Rail Kit includes hardware to mount to rack rails with either 6mm threaded holes, #10-32 threaded holes, #10 clearance holes, or square unthreaded holes per ANSI/EIA 310-D-1992 or IEC 60927 standards. Note that not all third-party racks are compatible with the slide rail kit. Rack density will vary widely based on systems installed, power distribution (in-cabinet or external), power source (single-phase or three-phase), and whether redundant power is required.

## RAS features

Corporate data and business information comprise critical business assets. Enterprise computing technologies strive to furnish a high degree of data protection (reliability), to provide virtually continuous application access (availability), and to incorporate procedures and components that help to resolve problems with minimal business impact (serviceability). Commonly referred to as RAS, these capabilities are a standard part of Sun's mission-critical computing solutions.

The Sun Fire X4170, X4270, and X4275 servers are engineered for hardware failure prevention, near continuous operation, fast recovery, and easy serviceability. RAS features for these systems include:

- *High CPU density.* Multiple Intel Xeon processors in 1U and 2U form factors enable density that increases overall availability.
- *Hot-swappable redundant components.* Mirrored disks, redundant fan modules, and redundant PSUs can be quickly and easily changed out, increasing system uptime.
- *Accessible components for improved serviceability.* Front-accessible, hot-swappable disk drives can be replaced quickly. The optional DVD/RW drive can also be removed without opening the top cover of the chassis. Fan modules and power supply units can be replaced without completely removing a system from the rack.
- *A variety of RAID options, allowing customers to balance storage capacity, availability, and cost.* The LSI-based Sun StorageTek SAS HBA with internal connectors supports RAID 0, 1, 1E, and 10E, while the Sun StorageTek SAS RAID host bus adapter supports RAID 0, 1, 10, 1E, 5, 50, 5EE, 6, 60 and also features a battery-backed disk write cache.
- *Indicator LEDs on the front and back of the chassis.* Easily visible LEDs allow problems to be identified and isolated easily. Diagnostic LEDs are also included on the motherboard.
- *Integrated lights-out management (ILOM) capabilities.* Standard on the Sun Fire X4170, X4270, and X4275 servers at no additional charge, the integrated ILOM service processor provides powerful tools for local or remote system management, simplifying administrative tasks, reducing on-site personnel needed, and lowering overall operational costs. (Chapter 4 discusses system management capabilities.)

Chapter 4

# ILOM Service Processor and System Management

The need for high availability in business-critical systems calls for robust and proactive system management. Like many other Sun servers, the Sun Fire X4170, X4270, and X4275 servers feature a built-in, hardware-based service processor that enables remote server monitoring, system management, and task automation capabilities that are consistent across much of the Sun server product line.

## Sun ILOM service processor

The Sun Fire X4170, X4270, and X4275 servers embed an Aspeed AST2100 chip as the on-board service processor (i.e., the Baseboard Management Controller or BMC). The Aspeed AST2100 combines a graphics controller and a service processor into a single chip, saving space and power. It uses two USB ports for virtual devices and one 32-bit, 33Mhz PCI bus for video to connect to the ICH10R (refer back to system block diagrams in Chapter 3).

The Sun ILOM service processor provides lights-out management, which can help organizations simplify system management. The service processor runs independently of the host platform, executing a robust, security-hardened operating system.

Capabilities of the Sun ILOM service processor include the following:

- Full local and remote keyboard, video, mouse, and storage (RKVMS) access via redirection over IP, eliminating the need for KVM switches
- Monitoring and reporting of environmental, power, hardware, BIOS, and operating system events
- Remote power control, diagnostics, media attachment, and flash upgrades of the system BIOS and service processor software
- System configuration information retrieval
- User configurable serial console access through a physical port or redirected over IP
- Java-enabled remote console access across a secure Web connection
- Multi-level role based access with support for RADIUS, LDAP, and Microsoft Active Directory Service lookup of authentication data
- Simple Network Management Protocol (SNMP) V1, V2c, and V3 support

For system management operations, the Aspeed AST2100 uses these connections:

- Two USB ports for virtual devices (both ports are routed directly on the motherboard between the AST2100 and the ICH10R)
- Two serial ports (one external, one to the ICH10R)
- Two Ethernet interfaces for IP-based management connections (one external for out-of-band management, one to the Intel NIC controllers for side-band management)

- One SVGA video port for local video output
- One 33 MHz, 32bit PCI connection to the ICH10R for video

Management functions provided by the service processor are implemented by Sun ILOM 2.0 system management software. This software provides an Intelligent Platform Management Interface (IPMI 2.0) Baseboard Management Controller, platform control agents, diagnostics software, and Remote Keyboard, Video, Mouse, and Storage (RKVMS) drivers. Many other Sun servers incorporate this same firmware, providing organizations with a single, consistent, and standards-based management interface.

Secure access to the service processor and associated ILOM software functions is available in several ways:

- Intuitive browser-based user interface (BUI) over SSL
- Distributed Management Task Force (DMTF) command line interface over Secure Shell (SSH)
- Redirection of the platform console, keyboard, mouse, and video to the ILOM Remote Console application
- SNMP v3 interfaces, providing easy integration with Sun xVM Ops Center, or third-party applications from companies such as Hewlett-Packard and IBM
- IPMI 2.0 command interface for remote management using IPMI-based tools, such as IPMItool

## Optimizing management flexibility

While system management tools can play an important role in streamlining operations, organizations must consider the best approach for each environment. Executing management software directly on the host (with or without use of a service processor) is known as *in-band* management. Using a dedicated Ethernet or serial port to execute administrative tasks independently of the host is known as *out-of-band* management. Sharing a single Ethernet port for host and service processor network connectivity is called *side-band* management, which is enabled in these servers through a connection between the Ethernet controllers and the service processor (Figure 12). Table 9 offers a comparison of these management strategies.

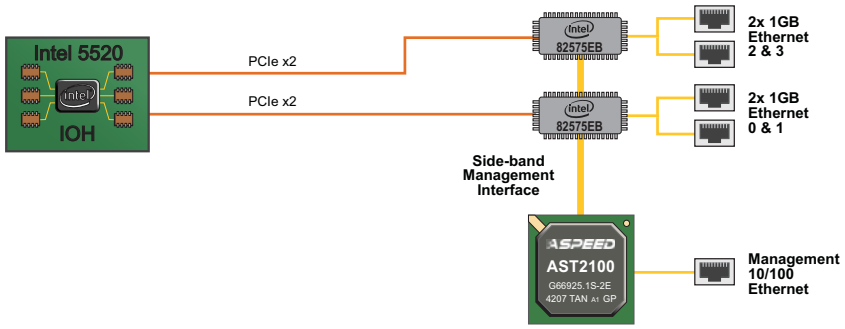


*Figure 12. The Sun ILOM service processor supports side-band management*

*Table 9. Comparison of in-band, out-of-band, and side-band management*

| Strategy | Characteristics | Benefits | Ideal use cases |
|---|---|---|---|
| In-band | Relies upon operating system-resident software<br><br>Management tasks utilize platform compute resources | Use of a single network connection and switch port minimizes cost and complexity | Heterogeneous environments with requirements to provide a common administrative tool across all platforms |
| Out-of-band | Utilizes a dedicated Ethernet or serial port for administrative traffic<br><br>Management tasks execute on an independent service processor | Continuous access to management capabilities even when host is disabled<br><br>Management tasks do not consume host resources<br><br>Increased security by physically separating management traffic and server data | Environments with compute or bandwidth intensive applications<br><br>Projects with complex management requirements or high-levels of administrative burden |
| Side-band | The host and service processor share an Ethernet port and are each assigned an independent MAC and IP address<br><br>Management tasks execute on an independent service processor | Continuous access to management capabilities even when host is disabled<br><br>Management traffic uses part of the server data bandwidth<br><br>Requires only one switch port, lowering implementation costs<br><br>Minimizes processing overhead on the host | Cost-sensitive environments |

The Sun Fire X4170, X4270, and X4275 servers offer extensive flexibility by supporting all three of these strategies — in-band, out-of-band, and side-band management. Organizations can choose a single management method or use in-band management in tandem with out-of-band or side-band management approaches.

The Sun Fire X4170, X4270, and X4275 servers provide out-of-band management across a dedicated 10/100 Mb Ethernet port or an RS-232 serial port on the Sun ILOM service processor. Side-band management is supported over one of the four Gigabit Ethernet interfaces shared between both the host and the service processor. When using a side-band management approach, both the platform and the service processor each get a unique MAC address and IP address for the shared physical Ethernet port. When configured, side-band management can provide all the benefits of out-of-band management at considerable cost savings by eliminating the need to consume a switch port for both management and platform connections.

### In-band server management

In-band server management offers the opportunity for organizations to take advantage of industry-standard protocols and applications across all datacenter platforms. The Sun Fire X4170, X4270, and X4275 servers facilitate in-band server management by

supporting IPMI 2.0 and SNMP v1, v2c, and v3 standards. One of the following two options enable these operating system-resident platform management functions:

- IPMI with a Keyboard Controller Style (KCS) interface and an IPMI kernel driver
- SNMP agents

### Out-of-band and side-band management

Out-of-band and side-band management approaches support the completion of administrative tasks without placing unnecessary burden on the host. This administrative strategy is desirable for performance-intensive environments. While in-band management only works as long as the host operating system is up and running, out-of-band and side-band management are fully functional even while the host is powered off. For side-band management to work even while the host is shut down, the two dual-Gigabit Ethernet (Zoar) controllers operate using stand-by power, similar to the service processor.

Although out-of-band and side-band approaches differ with respect to network connectivity, these methods offer comparable capabilities and benefits.

- Based on serial port redirection (serial-over-LAN), serial port connectivity to the ILOM Service Processor provides direct console access to the command line interface (CLI) and to the system console stream. The CLI is designed to follow the Distributed Management Task Force (DMTF) Command Line Protocol (CLP).
- Utilizing Ethernet connectivity, administrators can access a Web interface or command-line interface (CLI). A secure shell (SSH) session is required for access to the CLI and the Web interface supports both secure (`https`) and non-secure (`http`) access. Secure access is the default configuration for Web-based access.

## Remote keyboard, video, mouse, and storage (RKVMS)

The ILOM Service Processor provides access to Keyboard, Video, Mouse, and Storage (RKVMS) remotely over IP. Remote video display is accomplished through the Java™ Web Start software known as Sun ILOM Remote Console. To set up a system as a remote console, ILOM Remote Console software is downloaded from the ILOM service processor to the target machine.[2] From this point onward, the ILOM Remote Console executes locally. Since ILOM Remote Console does not run locally on the server, it does not put overhead on the host. A single instance of ILOM Remote Console can open multiple sessions, enabling management of several remote servers simultaneously.

ILOM Remote Console software can be used to redirect the BIOS and setup screens as well as all other platform video output. A true remote video console to the management console is provided by handling the input and output to and from virtual devices and the Sun Fire X4170, X4270, and X4275 servers. With 8-bit and 16-bit support, 8 MB of video memory, the SVGA display provide resolutions up to 1280 x 1024.

2. ILOM Remote Console requires the installation of Java Runtime Environment 5.0 on the management console.

The two USB 2.0 ports connected to the ILOM service processor enable the remote keyboard, mouse and storage functions. The ILOM Remote Console software captures keyboard, mouse and floppy/CD/DVD input on the management console and redirects it over IP to the ILOM service processor. Keyboard, mouse and storage inputs are then transmitted over the USB ports to the server. The Sun Fire X4170, X4270, and X4275 servers interpret these inputs as originating from locally connected USB devices, which are referred to as “virtual” devices.

ILOM Remote Console can also be used to boot the remote server from a local device. A virtual device can be a local physical device or an image file. Several types of devices can be redirected as virtual devices by ILOM Remote Console:

- CD/DVD-ROM
- Floppy
- USB flash disk drives
- CD/DVD-ROM image (`.iso` files)
- Floppy image (`.img` files)

## Intelligent platform management interface

Intelligent Platform Management Interface (IPMI) platform management refers to the autonomous monitoring, logging, recovery, and inventory control features implemented in hardware and firmware. The key differentiation of Intelligent Platform Management is that these functions are independent of the main CPU, BIOS, and OS. There are two major components of platform management: the Baseboard Management Controller (BMC) and System Management Software (SMS). Intelligent Platform Management offers key capabilities for providing enterprise-class management for high-availability systems.

The ILOM service processor provides autonomous sensor monitoring and event logging. Typical sensor-related events are an out-of-range temperature or voltage and fan failures. When an event occurs, it is noted in the system event log and made available to the system management controller. The system management controller is powered by power supply stand-by voltage and will function even when the server is powered down or the operating system has crashed. As a result, platform status can be obtained and recovery initiated even under situations in which in-band delivery mechanisms are unavailable.

In modern systems, the Intelligent Platform Management Interface (IPMI) provides a hardware-level interface specification for monitoring and control functions. It defines a standard, abstract, message-based interface between the BMC and SMS and a common set of commands for operations such as accessing sensor values, setting thresholds, logging events, and controlling a watchdog timer. IPMI messages can be used to communicate with the BMC over serial and LAN interfaces, so software designed for in-

band (local) management can be re-used for out-of-band (remote) management simply by changing the low-level communications layer.

### IPMItool

IPMItool is a simple command-line interface to systems that support the IPMI v2.0 specification. IPMItool provides the ability to remotely read sensor data and print sensor values, display the contents of the system event log, print field-replaceable unit information, read and set LAN configuration parameters, and perform remote chassis power control. IPMItool was originally written to take advantage of IPMI-over-LAN interfaces. This tool is also capable of interfacing with the system through a Linux kernel device driver such as OpenIPMI or the Solaris BMC driver within the Solaris 10 OS. IPMItool is available under a BSD-compatible license.

System Management Software (SMS) is generally complex and is only part of a much larger management picture. However, system administrators and developers can use command-line scripting to manage these complex systems. IPMItool takes a different approach to SMS and provides a completely command-line oriented tool. IPMItool is not designed to replace the OpenIPMI library. Where possible, IPMItool supports printing comma-separated values for output to facilitate parsing by other scripts or programs. IPMItool is designed to run quick command-response functions that can be as simple as turning the system on or off, or as complex as reading in sensor data records and extracting and printing detailed sensor information for each record.

## New features in ILOM3.0

Since ILOM system management functionality is implemented in firmware, it can be easily upgraded even after a server is deployed. Shortly after the initial product release of the Sun Fire X4170, X4270, and X4275 servers, ILOM 3.0 will be available as a no-charge upgrade, offering enhancements over the current ILOM 2.0 functionality. ILOM 3.0 provides many new features and capabilities, including improved security, improved usability, and easier integration into the datacenter environment. Table 10 lists examples of new features for ILOM 3.0.

*Table 10. Examples of ILOM 3.0 new features*

| Category | Feature |
|---|---|
| General | • DNS support<br>• Timezone support<br>• Configuration backup and restore<br>• Restore to factory defaults<br>• Enhanced LDAP and LDAP/SSL support<br>• Java-based remote storage CLI<br>• Power management capabilities<br>• Ability to generate new SSH keys |
| Scalability and Usability | • User-configurable filtering of hardware monitoring information in CLI and Web interface<br>• Use host name to access other services by name, such as LDAP, Active Directory, LDAP/SSL |
| Security | • More granular user roles<br>• Predefined root and default accounts<br>• User SSH key authentication<br>• Ability to disable the network management port when you are using only the serial port<br>• Ability to disable individual services, such as IPMI, SSH, and KVMS, so that the port is closed<br>• Serviceability<br>• Data collection utility to diagnose system problems |

More information about ILOM 2.0 and 3.0 features is available in the documentation sets, which are available on docs.sun.com.

## SNMP

The Simple Network Management Protocol (SNMP) provides remote access to monitor and control network devices and to manage configurations, statistics collection, performance, and security on a network. SNMP is a network management protocol used almost exclusively in TCP/IP networks. The Sun Fire X4170, X4270, and X4275 servers provide SNMP MIBs (Management Information Bases) to manage and monitor the servers using any SNMP-capable network management system, such as HP OpenView Network Node Manager (NNM), Tivoli, CA Unicenter, or IBM Director. The MIB data describes the information being managed, reflects current and recent server status, and provides server statistics.

The ILOM service processor supports SNMP v1, v2c, and v3. SNMP v3 is enabled by default; v1 and v2c are disabled by default. SNMP sets may be enabled and disabled and are disabled by default. SNMP traps can be generated from within the service processor. An IPMI-specific trap, called a Platform Event Trap (PET), may also be generated. The following SNMP MIBs are supported:

- The system group and SNMP group from the RFC1213 MIB
- SNMP-FRAMEWORK-MIB
- SNMP-USER-BASED-SM-MIB
- SNMP-MPD-MIB
- ENTITY-MIB
- SUN-PLATFORM-MIB

## Sun™ xVM Ops Center

Sun™ xVM Ops Center software is a highly-scalable datacenter management platform that provides organizations with a fluid systems lifecycle management and automation process. The capabilities of Sun xVM Ops Center can help organizations simplify management of datacenter requirements such as server consolidation, compliance reporting, and rapid provisioning. This management platform helps provision and administer both physical and virtual datacenter assets in environments that include Sun Fire X4170, X4270, and X4275 servers as well as other Sun and non-Sun hardware running Windows and Linux operating systems and the Solaris OS.

Sun xVM Ops Center provides a single console to facilitate the following key capabilities within globally dispersed heterogeneous IT environments:

- *Server discovery and inventory management*— Automatically scans and identifies servers across the network, even when powered off, allowing faster deployment and management of IT assets.
- *Firmware and bare metal server provisioning* — Delivers automatic and "hands off" installation of bare-metal operating systems, RPMs and firmware, bringing new efficiencies to IT departments.
- *Patch management and updating* — Provides up-to-date patch management tools for Red Hat, SUSE, and the Solaris OS, offering organizations greater control over datacenter plans and minimizing downtime. In addition, unique patch simulation capabilities remove uncertainty from the software update process.
- *Managing and monitoring* — Securely and remotely manages users and heterogeneous datacenter assets, and proactively resolves problems by monitoring critical parameters, improving the security and stability of systems.
- *Compliance reporting*— Provides an up-to-date view into the system state, patch status, and software portfolio, helping improve the speed and accuracy of report and compliance validation.

These automation capabilities can be used in conjunction with configuration management investments to achieve knowledge-based change management. Taking advantage of Sun xVM Ops Center software can help organizations create a more compliant Solaris OS environment that requires less maintenance and recovery down time and can lead to considerable cost savings.

Chapter 5

# Enterprise-Class Software Support

To provide both flexibility and investment protection, the Sun Fire X4170, X4270, and X4275 servers support multiple 32-bit and 64-bit operating systems, including the Solaris and OpenSolaris Operating Systems, Linux, Microsoft Windows, and VMware environments. Sun's support for multiple operating systems enables organizations to deploy a choice of application environments without having to shift hardware platforms when software requirements change. This added flexibility enables enterprises to reduce cost and complexity when supporting and managing solutions from multiple vendors, helping organizations to reduce risk and increase ROI.

The Sun Fire X4170, X4270, and X4275 servers are certified to run the following operating system versions (subsequent releases of these operating systems are also expected to be supported and Sun-qualified):

- Solaris 10 10/08 Operating System (OS)
- OpenSolaris 2008.11 Operating System
- Red Hat Enterprise Linux 4.7 (32-bit or 64-bit) or Red Hat Enterprise Linux 5.3 (64-bit)
- SUSE Linux Enterprise Server 10 SP2 (64-bit)
- VMware ESX 3.5 U4 and VMware ESXi 3.5 U4
- Windows Server 2003, Standard and Enterprise Editions (32-bit or 64-bit)
- Windows Server 2008, Standard, Enterprise, and Datacenter Editions, 32 and 64-bit

Additional patches and drivers required to complete the installation of these operating systems are available from the Web site sun.com/download/ or on the Tools and Drivers CD-ROM provided with every Sun Fire X4170, X4270, and X4275 server. The drivers and installation scripts on the Tools and Drivers CD-ROM help to reduce the complexity of installing supported operating system distributions (since additional device drivers are included on the CD-ROM). Note that the Solaris 10 OS, Red Hat Enterprise Linux 5, SUSE Linux Enterprise Server 10, Windows Server 2008, and VMware ESX are available directly from Sun along with support contracts. In addition, the Sun Fire X4170, X4270, and X4275 servers come with the Solaris 10 OS pre-installed, or can be ordered with Windows Server 2003 or 2008 media.

## The Solaris™ Operating System

Sun and Intel, as part of a strategic alliance, have been working together — from design and architecture through implementation — to ensure that the Solaris OS is optimized to unleash the power and capabilities of current and future Intel Xeon processors at the time of launch. Since 2007, engineering teams from the two companies have delivered a range of enhancements for Solaris on Xeon processors. They collaborated on optimizing how the Solaris platform and the New Intel Core

Microarchitecture work together on the Intel Xeon processor 5500 series, with compelling results:

- *Improved performance* — The Solaris OS takes advantage of the Intel Xeon Processor 5500 Series, including Intel Hyper-Threading Technology, Intel Turbo Boost Technology and the new Intel QuickPath Technology, resulting in significant performance improvements.
- *Automated power efficiency and utilization* — The Solaris OS has been optimized to leverage Intel's power management functions, improving energy efficiency and performance-per-watt through Integrated Power Gates and Automated Power States.
- *Increased reliability, availability, and serviceability (RAS)* — The Solaris Fault Management Architecture (FMA) infrastructure is enhanced to take advantage of the Intel Xeon processor 5500 series RAS features to provide an even stronger enterprise computing solution.
- *Virtualization enhancements* — The Solaris OS delivers cost-effective virtualization through Intel Virtualization Technology features.

Distributed under a commercial and open source licensing model, the Solaris 10 OS offers many innovative technologies that change the equation for organizations needing to reduce costs, minimize complexity, and eliminate risk. The Solaris 10 OS is optimized for Sun systems and supported on over one thousand third-party x86 systems. In addition, the Solaris 10 OS is free for download without requirement to purchase a support contract, offering an economic advantage over other community-based operating system offerings. The Solaris 10 OS also includes more than 180 applications from the free and open source software (F/OSS) community, and thousands of others are freely available for download over the Internet.

The Solaris OS includes features not found in any other operating system, including:

- *Solaris Dynamic Tracing (DTrace)* is a powerful tool that provides a true, system level view of application and kernel activities, even those running in a Java Virtual Machine. System administrators, integrators, and developers can use this dynamic instrumentation to reduce the time to diagnose problems from days and weeks to minutes and hours, providing faster data-driven fixes.
- *Solaris Containers* technology provides a powerful approach to virtualization and software partitioning, yielding many private execution environments within a single instance of the Solaris OS. Using this technology, organizations can improve resource utilization, reduce downtime, and lower solution costs.
- *Sun Predictive Self Healing* technology automatically diagnoses, isolates, and recovers from many hardware and application faults. As a result, business-critical applications and essential system services can continue uninterrupted in the event of

software failures, major hardware component breakdowns, and software misconfiguration problems.

- Resource management facilities built into the Solaris 10 OS allow computing resources to be allocated among individual tasks and users in a structured, policy driven fashion. Using the Solaris OS resource management facilities to proactively allocate, control, and monitor systems. Resources such as CPU time, processes, virtual memory, connect time, and logins can be managed on a fine-grained basis to help organizations obtain more predictable service levels.

## Linux environments

Sun offers and supports the leading Linux variants on the Sun Fire X2270 server, including Red Hat Enterprise Linux and Novell SUSE Linux Enterprise Server. As the leader in enterprise services for UNIX® software, Sun brings decades of expertise to Linux environments. Sun support contracts for Linux provide all front-line support and transparent access to back-line support from Red Hat and Novell.

Sun is one of the largest contributors to the open-source community. Areas of contribution include OpenOffice.org, Mozilla, GNOME, and X.org. In addition, Sun provides key software offerings for Linux including the following:

- Lustre™ parallel file system
- Sun Ray™ Server Software
- Sun xVM software
- StarOffice™ productivity suite
- Java Desktop Powered Program
- Sun Studio, Sun Java Studio Creator, and NetBeans™ IDE software
- MySQL™ database

## Microsoft Windows environments

Organizations strive to reduce variety of platforms in the data center, even when a wide range of workloads are present. To help this effort, the Sun Fire X4170, X4270, and X4275 servers can run the Microsoft Windows operating environment. Indeed, these servers have passed stringent Microsoft compatibility test suites. Support contracts for Microsoft Windows are also available from Sun. This certification and support demonstrates Sun's commitment to providing the best platforms to run not only the Solaris OS and Linux, but Windows as well.

## VMware support

Virtualization solutions from VMware help improve asset utilization, operational efficiency, and business agility. Sun offers the VMware Infrastructure product suite on Sun hardware systems with full support from Sun. VMware virtualization technology

also combines with key Solaris 10 OS features such as, DTrace, Solaris Containers, and Solaris Predictive Self Healing software. As a result, organizations can create powerful IT solutions through virtualization. In fact, utilizing VMware virtual infrastructure software with the Solaris 10 OS for consolidation projects can increase system utilization by up to ten times. By taking advantage of technology from VMware, enterprises can further capitalize on the high-performance, scalability, and energy efficiency of the Sun Fire X4170, X4270, and X4275 servers.

Chapter 6
# Summary

IT departments face increasing pressure to deliver new services and satisfy escalating resource demands for new applications and users. The Sun Fire X4170, X4270, and X4275 servers offer exceptional system density, with compute, memory, networking, storage, and I/O expansion capabilities in compact 1U and 2U form factors. Leveraging a new generation of Intel Xeon processor technology and Sun's Open Network System approach in systems design, these platforms deliver new levels of performance — and new levels of performance-per-watt — in a rack-mountable chassis. Deploying these servers can create a more agile infrastructure that can scale to meet new business challenges while maintaining a small space and energy footprint, delivering new levels of efficiency and datacenter value.

The Sun Fire X4170, X4270, and X4275 servers provide expandable, high-capacity resources needed for demanding HPC grid computing, Web infrastructure, database, and server consolidation and virtualization initiatives. These systems are ideal for a variety of industries, especially those installations where performance, density, and energy conservation are paramount. Given the speed and energy efficiency of these servers, IT departments can easily consolidate workloads and improve utilization — at the same time preserving investments in x86 and x64 applications.

Sun offers professional services, training, and integrated support to optimize server implementations and speed time-to-deployment. Experienced Sun specialists can assist with datacenter capacity planning, and consolidation and virtualization strategies. To experience the density and power of the Sun Fire X4170, X4270, and X4275 servers first-hand, contact your Sun account representative or visit www.sun.com/servers.

## For more information

For more information on Sun Fire X4170, X4270, and X4275 servers and associated Intel chipsets, visit the Web sites:

- sun.com/x4170/
- sun.com/x4270/
- sun.com/x4275/
- sun.com/servicessolutions/
- sun.com/x64

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